

Hudson River PCBs Site

Engineering Performance Standards For Dredging

Presentation to Peer Review Panel



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Resuspension Performance Standard

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Outline

- Requirements of the ROD
- Definitions
- Objectives
- Resuspension Standard
 - Resuspension Criteria
 - Monitoring Requirements
 - Engineering Contingencies
 - Reverting to Lower Action Levels
- Supporting Analysis
 - Baseline Conditions
 - Engineering Considerations
 - Estimated Impacts
 - Case Studies
- Anticipated Refinements
- Public Comments

Requirements of the ROD

- Hudson River Record of Decision [USEPA, 2002]:

“Performance standards will address (but may not be limited to) resuspension rates during dredging...

...These performance standards will be enforceable, and based on objective environmental and scientific criteria. The standards will promote accountability and ensure that the cleanup meets the human health and environmental protection objectives of the ROD.”
(ROD § 13.1, page 88)

Requirements of the ROD (cont.)

- **The ROD also**

- Identifies several applicable or relevant and appropriate requirements (ARARs),
- Recognizes the need to conform with these federal and state requirements for water quality.

Requirements of the ROD (cont.)

- **Ultimately, the goal of this standard is to:**

- ...ensure that dredging operations are performed in the most efficacious manner, consistent with the environmental and public health goals of the project. (ROD § 11.5, page 85)

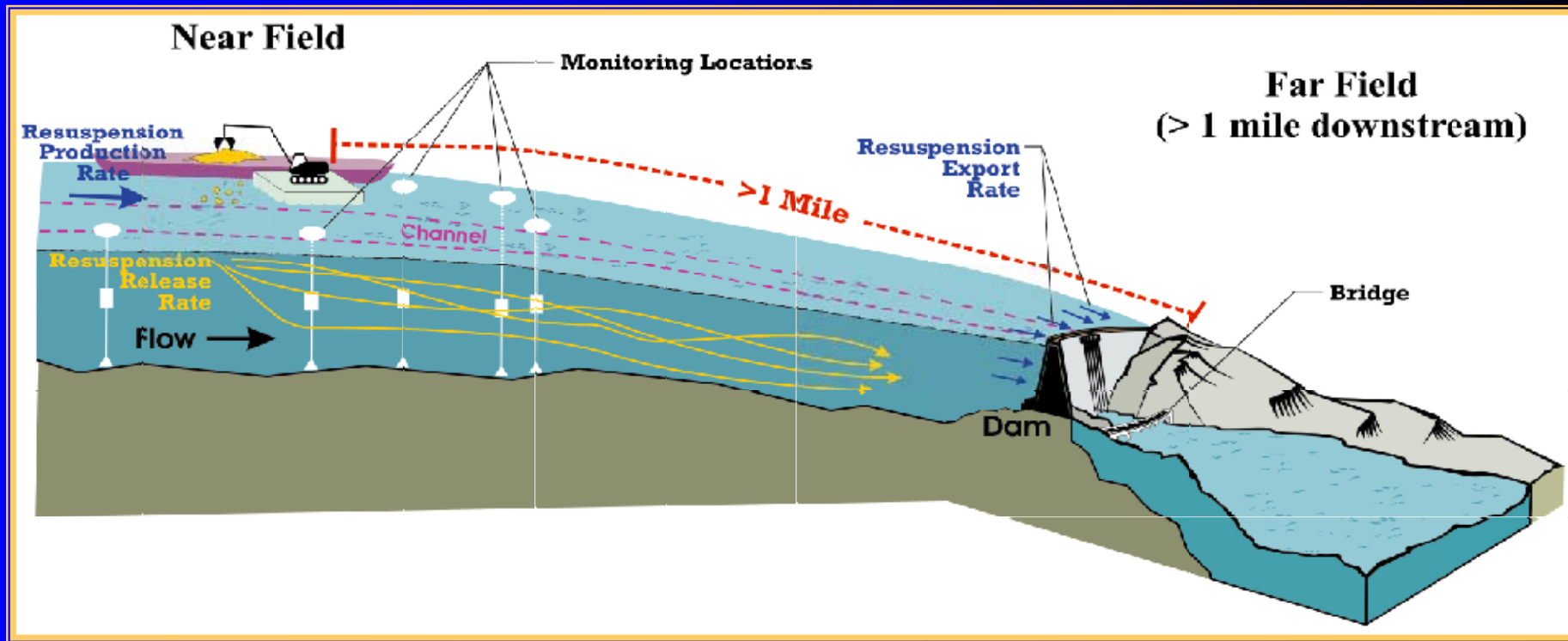
Phase 1 vs. Phase 2

- ...The information and experience gained during the first phase of dredging will be used to evaluate and determine compliance with the performance standards. Further, the data gathered will enable EPA to determine if adjustments are needed to operations in the succeeding phase of dredging, or if performance standards need to be reevaluated. (ROD § 13.1, page 97)
- Phase 1: Control and Investigate
- Phase 2: Control and Confirm

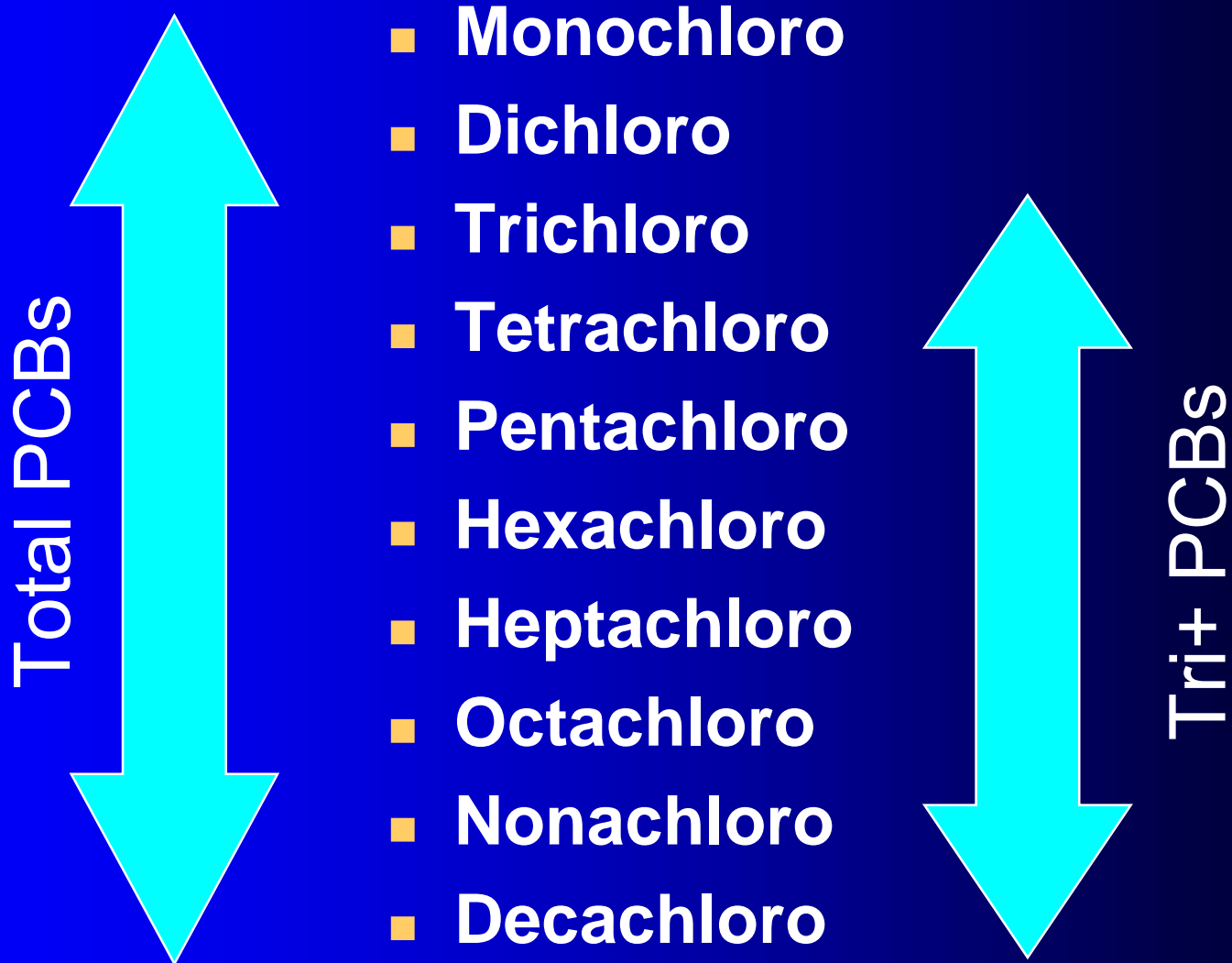
Objectives of the Resuspension Performance Standard

- Minimize PCB losses during dredging
 - Maintain acceptable PCB concentrations in raw water for downstream users (Waterford, Halfmoon, Lower Hudson)
 - Minimize long term net export of PCBs from dredged areas to control temporary increases in fish tissue concentrations as well as long-term impacts
- Encourage efficient sediment removal and minimize disruptions to the dredge operations

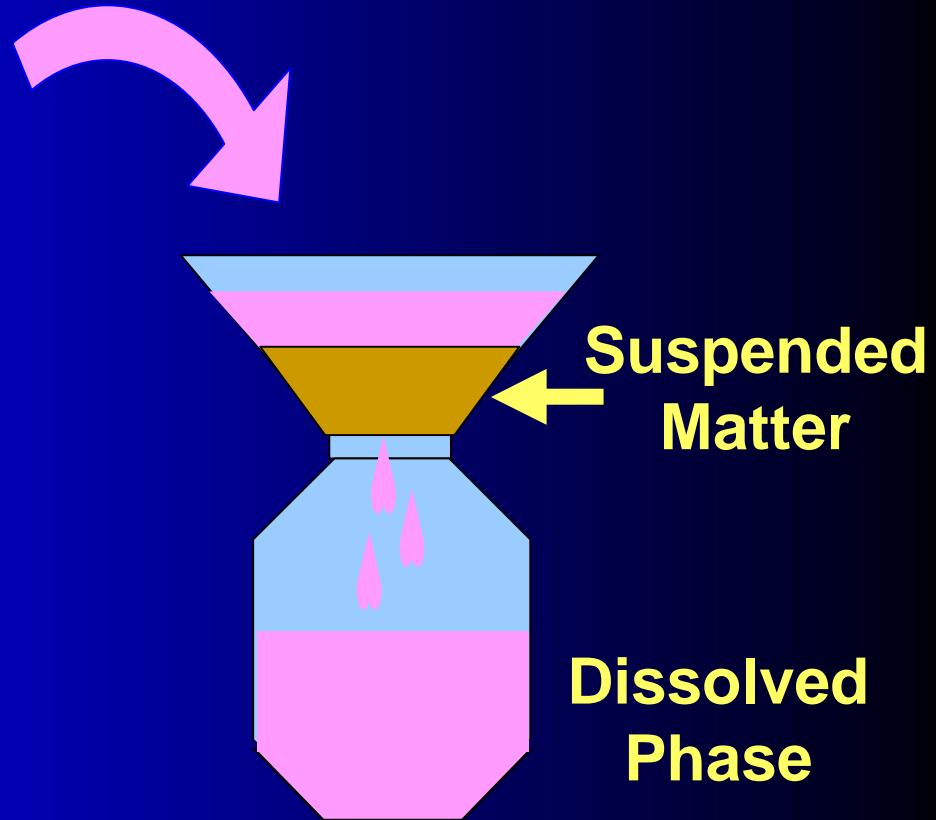
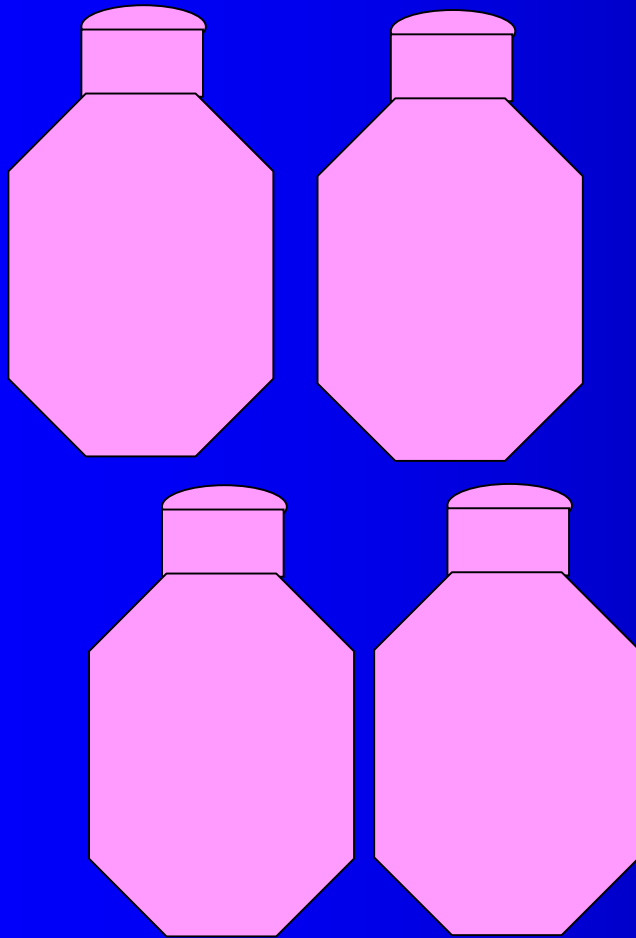
Definitions for the Standard



Total PCBs *vs.* Tri+ PCBs



Water Column Phases



Terminology

- Near-field area (1,000 yards downstream)
- Far-field area (>1 mile downstream)
- PCB loss due to resuspension
- Resuspension production rate
- Resuspension release rate
- Resuspension export rate
- Net export of PCBs to the Lower Hudson
- Dissolved Phase PCBs
- Particulate PCBs

Framework for the Standard

Components

- PCB Concentration and Load Limits (Resuspension Criteria)
- Water Column Monitoring Requirements
- Engineering Contingencies

Structure of the Resuspension Criteria

Resuspension Standard Threshold

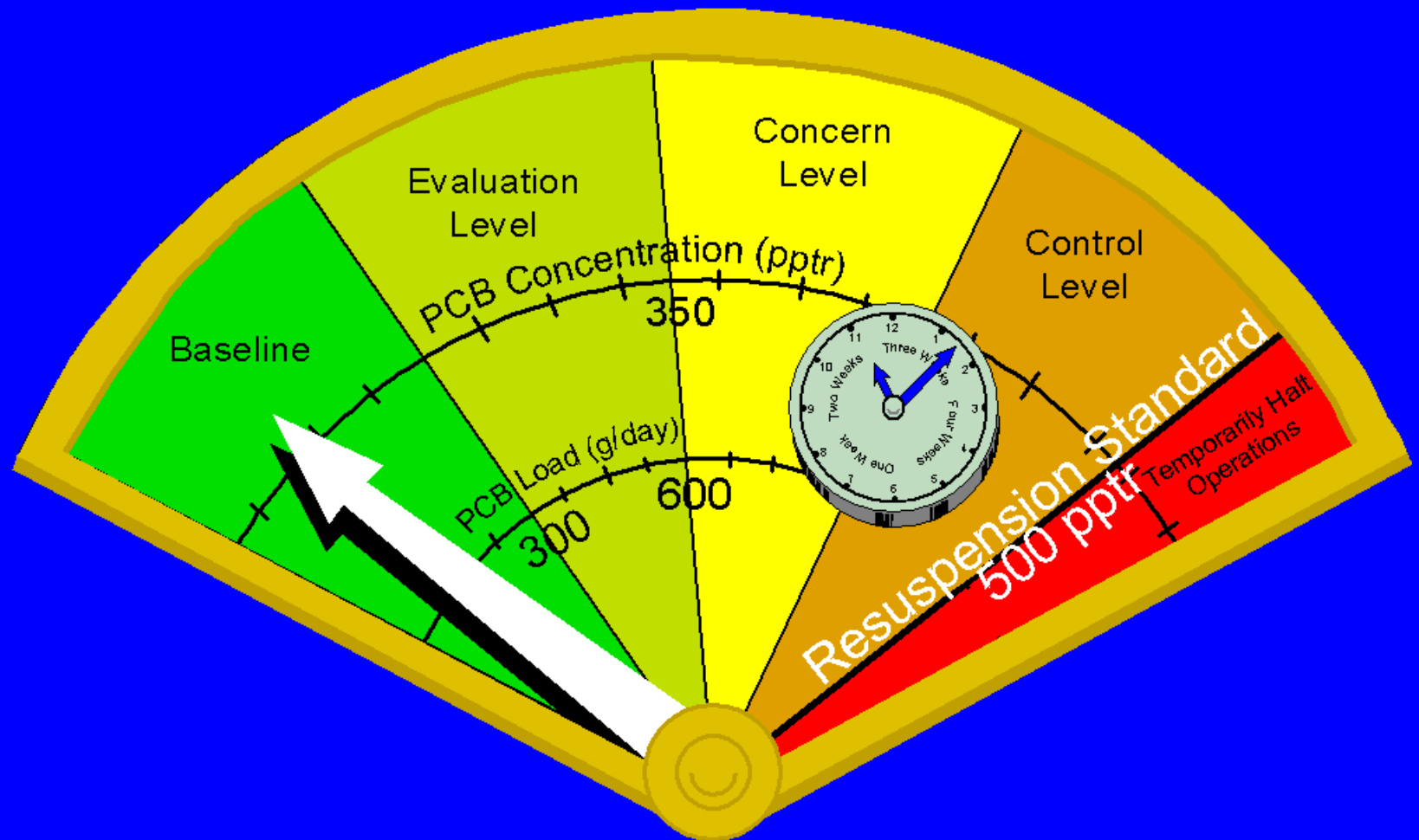
- Confirmed Occurrence of 500 ng/L

Total PCB

Action Levels

- Control Level
 - Concern Level
 - Evaluation Level

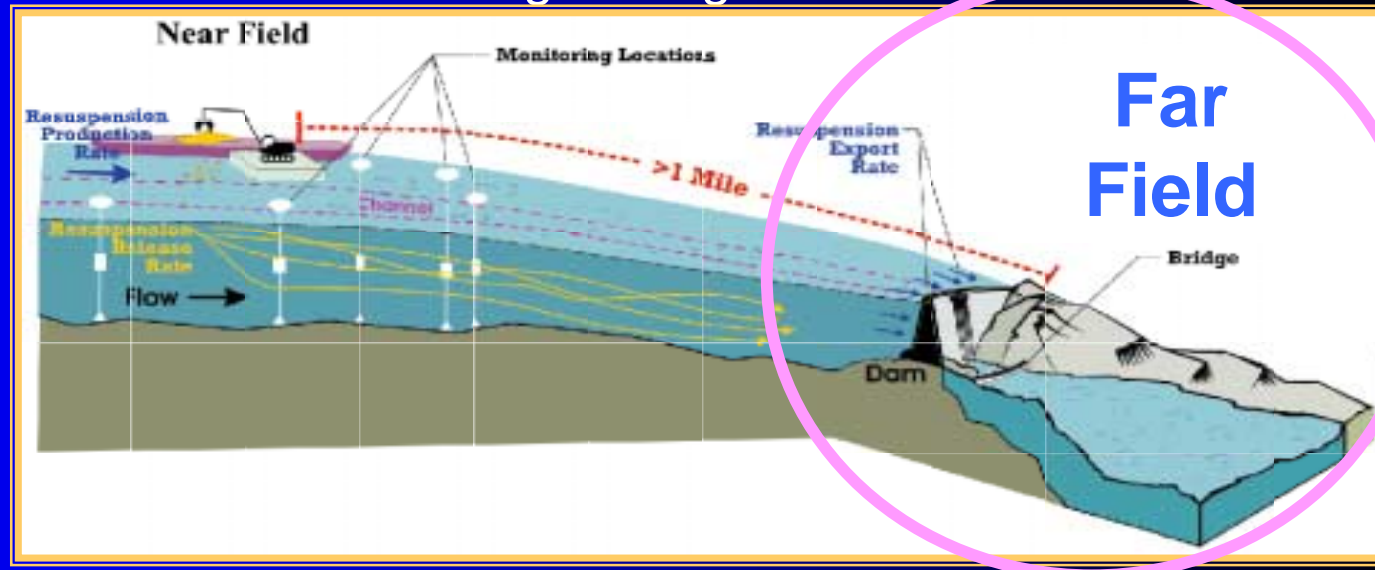
Resuspension Standard



Evaluation Level

■ Far-field Conditions

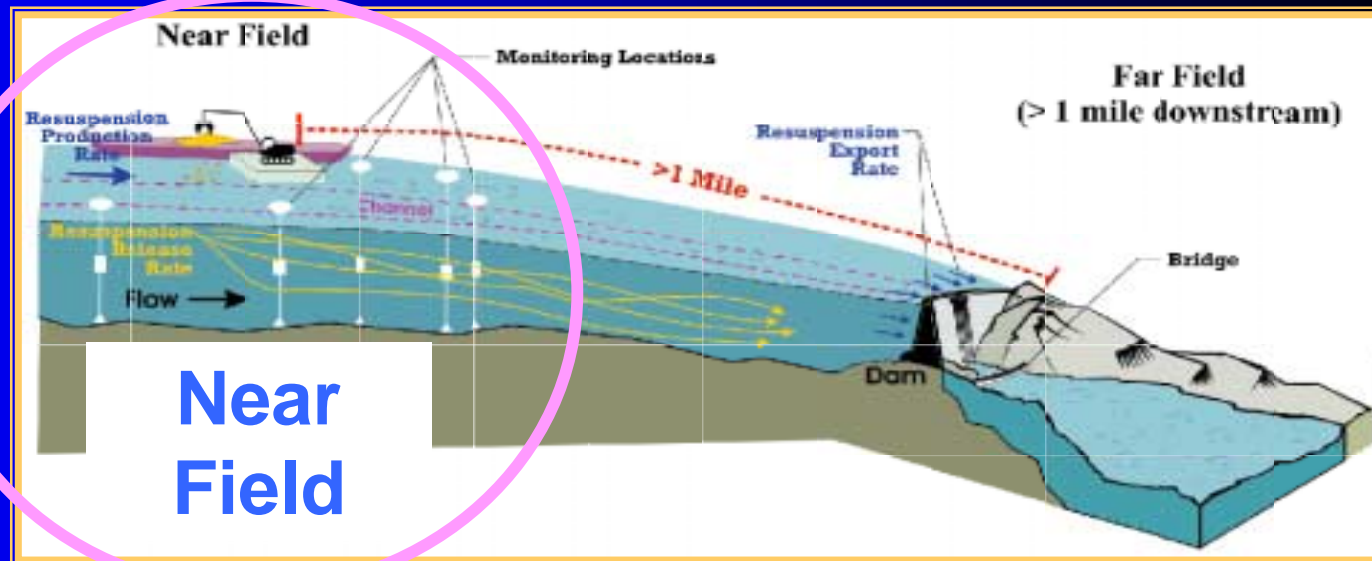
- Total PCB load > 300 g/day
- Tri+ PCB load > 100 g/day
 - 7-day running average.
- Suspended solids > 12 mg/L
 - measured as 6-hour running average



Evaluation Level

■ Near-field Conditions

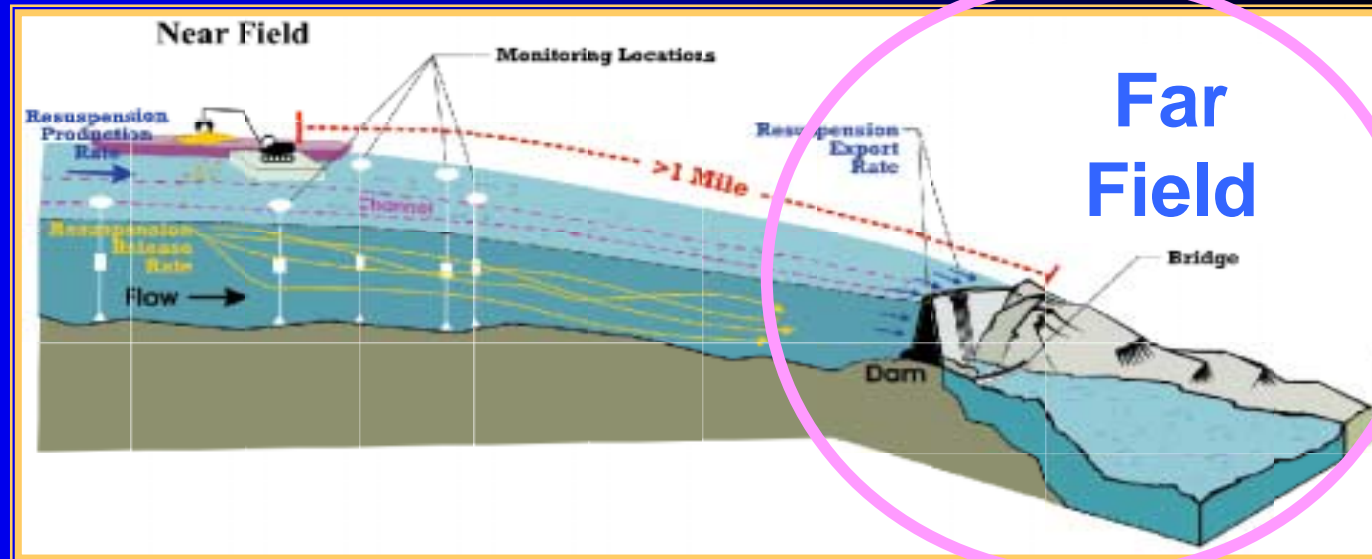
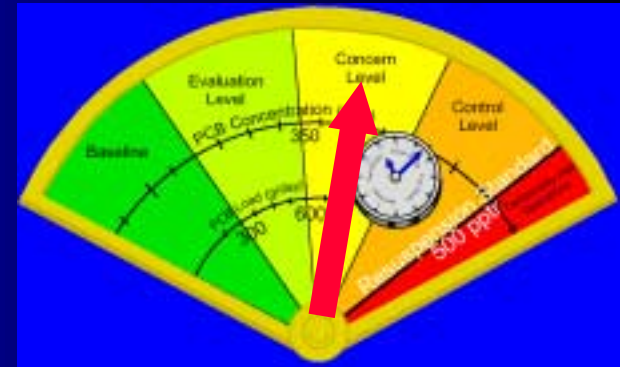
- Suspended solids >100 mg/L (300 m)
 - 60 mg/L for Section 2
 - 6-hour running average
- Suspended solids >700 mg/L (100 m)
 - 3-hour running average



Concern Level

■ Far-field Conditions

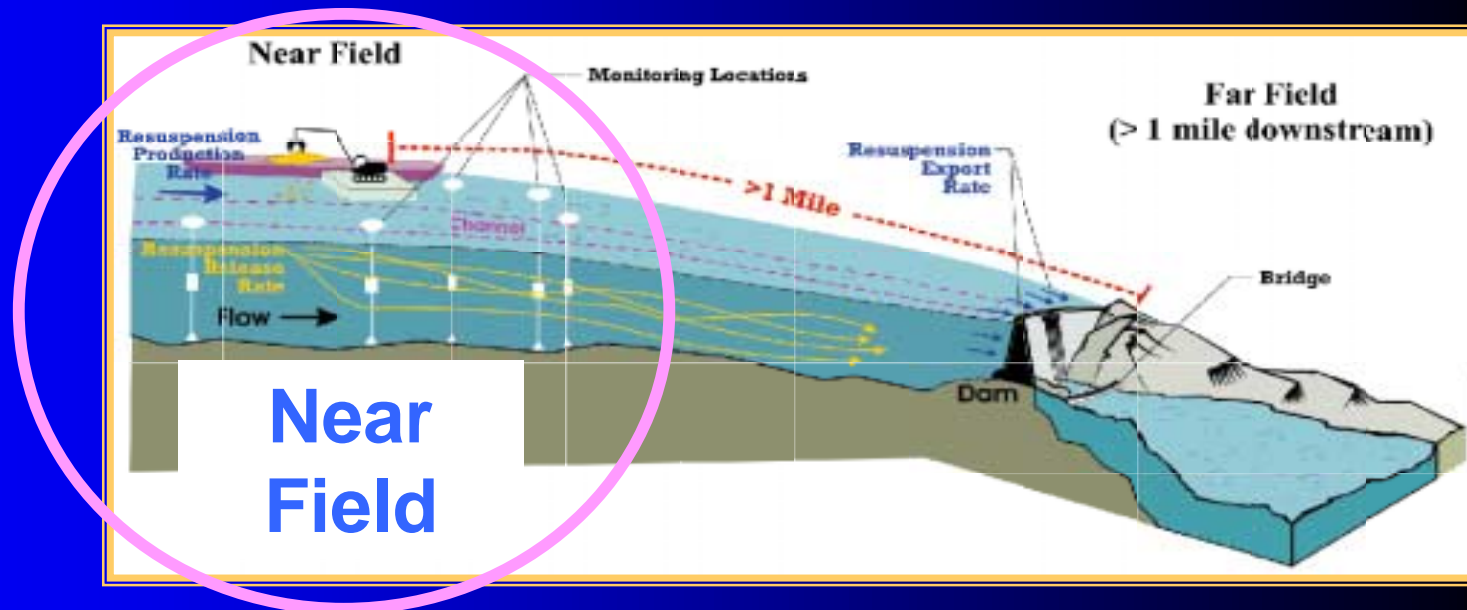
- Total PCB Conc > 350 ng/L
- Total PCB load > 600 g/day
- Tri+ PCB load > 200 g/day
 - 7-day running average.
- Suspended solids > 24 mg/L
 - measured as 6-hour running average



Concern Level

■ Near-field Conditions

- Suspended solids >100 mg/L (300 m)
 - 60 mg/L for Section 2
 - Daily dredging period or 24-hr average



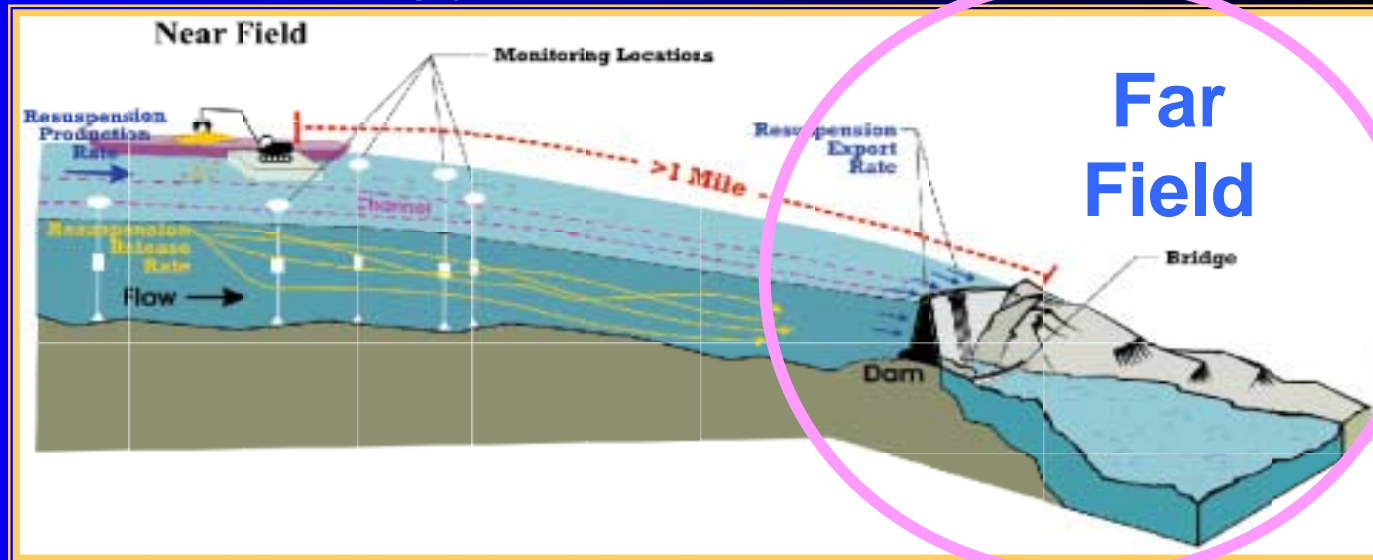
Control Level

■ Far-field Conditions

- 4-week Running Average
 - Same criteria as Concern Level
- Annual Load Criteria (Phase 1)
 - Tri+ PCB load >22 kg/year
 - Total PCB load > 65 kg/year



- No Near-field Criteria



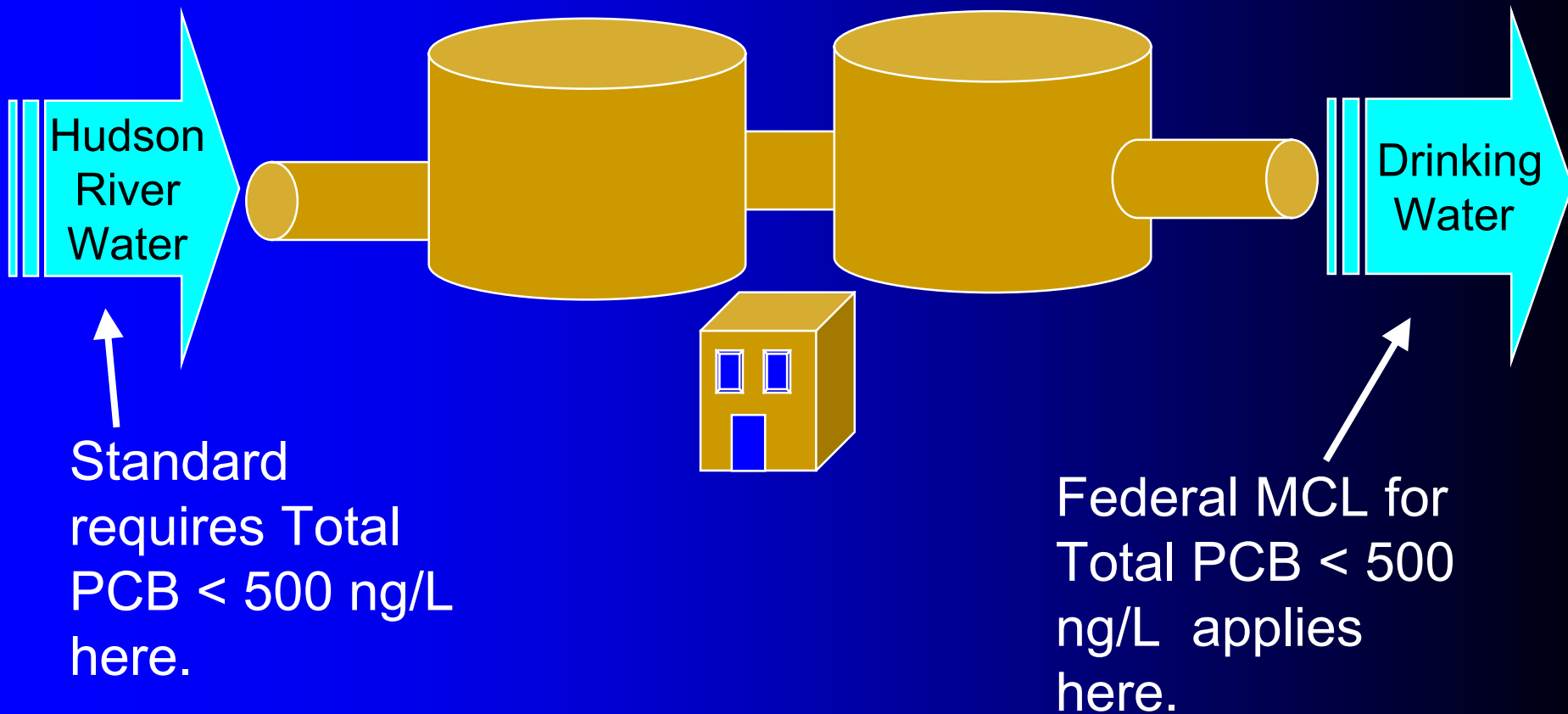
Resuspension Standard Threshold

- **Confirmed exceedance of the Federal Drinking Water MCL (500 ng/L)**
 - Measured at any far-field monitoring location



Resuspension Standard Threshold Is Protective

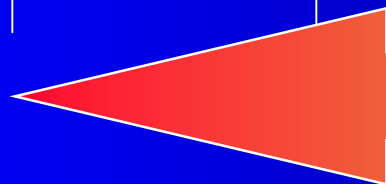
Waterford Water Treatment Plant



Summary Table 1-1

Resuspension Action Levels

Parameter		Standard Threshold		Control Level		Concern Level		Evaluation Level	
		Limit	Duration	Limit	Duration	Limit	Duration	Limit	Duration
Far-Field PCB Concentration	Total PCBs	500 ng/L	Confirmed Occurrence	350 ng/L	4-week running average	350 ng/L	7-day running average		
Far-Field Net PCB Load	Tri+ PCBs			22 kg/yr	Dredging Season				
	Total PCBs			65 kg/yr					
	Total PCBs			600 g/day	4-week running average	600 g/day	7-day running average	300 g/day	7-day running average
	Tri+ PCBs			200 g/day		200 g/day		100 g/day	
Far-Field Net Suspended Solids Concentration	All Sections					24 mg/L	Daily dredging period (> 6 hrs) OR 24 hrs. on average	12 mg/L	6-hour running average net increase OR average net increase in the daily dredging period if the dredging period is less than 6
Near-Field (300 m) Net Suspended Solids Concentration	Sections 1 & 3					100 mg/L	Daily dredging period (> 6 hrs)	100 mg/L	6-hour running average net increase OR average net increase in the daily dredging period if the dredging period is less than 6
	Sections 2					60 mg/L	OR 24 hrs. on average	60 mg/L	
Near-Field (100 m and Channel-Side) Net Suspended Solids Concentration	All Sections							700 mg/L	3 continuous hrs. running average.

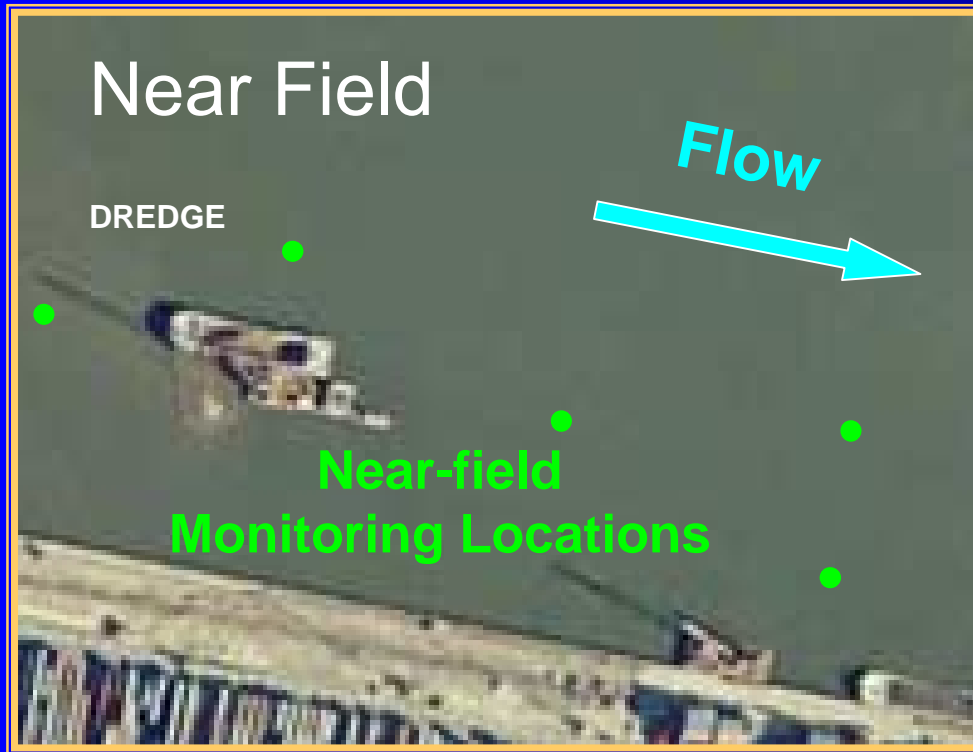


Increasing Concern

Monitoring Requirements

- **Monitoring Locations**
- **Monitoring Parameters**
- **Monitoring Frequency**
 - In response to Action Level

Monitoring Locations



Elizabeth Marine Terminal - Development Program



Plus Lower Hudson River Stations:

- Albany
- Poughkeepsie

Far-field Monitoring Parameters

■ Routine Daily Measurement

- Congener-specific PCBs,
- TSS, turbidity, organic carbon, temperature, pH, DO, conductivity, SS particle counters
- Discrete, cross-sectional grab samples
- Equal discharge increment (EDI) or equal width increment (EWI)
- Integrating samplers in main stem locations

Near-field Monitoring Parameters

■ Routine Daily Measurement

- Continuous Turbidity as surrogate of TSS
- TSS grabs depth-integrated water column samples
 - Every 3 hours during operations
 - One sample per day if a semi-quantitative relationship established
- Daily particle counter measurements

Phase 1 PCB Sample Requirements

Sample Type		Routine			Evaluation			Concern		
	Turn-Around Time	Normal	72 hr	24 hr	Normal	72 hr	24 hr	Normal	72 hr	24 hr
Baseline		0.07	1.14		0.07	1.14		0.07	1.14	
TI Dam & Schuylerville										
	Whole	0.14		2	0.14			0.28		
	Dissolved						4			6
	Suspended						4			6
Downstream		0.14	2		0.14	2			2	
	Subtotal	0.35	3.14	2	0.35	3.14	8	0.35	3.14	12
	Total		5.5			11.5			15.5	

Phase 1 PCB Sample Requirements (cont.)

Sample Type		Control			Standard Threshold		
		Normal	72 hr	24 hr	Normal	72 hr	24 hr
Baseline		0.07	1.14			2	
TI Dam & Schuylerville							
	Whole	0.28					
	Dissolved			8			9
	Suspended			8			9
Downstream				2			10
	Subtotal	0.35	1.14	18	0	2	28
	Total		19.5			30	

Daily PCB Analysis Requirements

Upper River Far-field Stations

- Routine Monitoring: 5.5
- Evaluation Level: 11.5
- Concern Level: 15.5
- Control Level: 19.5
- Resuspension Standard Threshold: 30

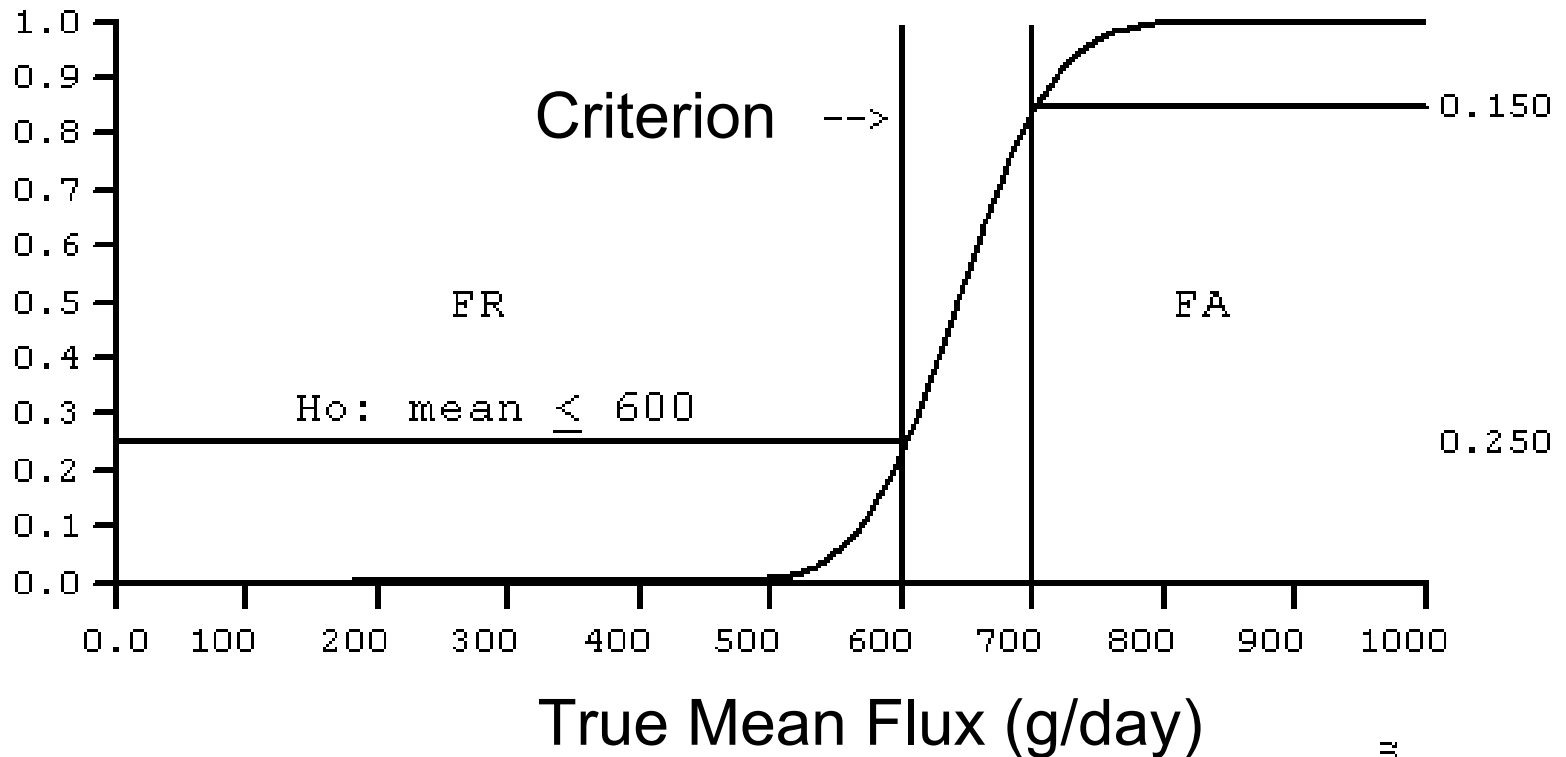
Sampling Frequency Development

- Based on false positive and false negative error considerations
- Higher monitoring frequencies (at Control Level and Standard Threshold) provide roughly 5 percent uncertainty
- Used EPA-developed software to determine sampling frequency to satisfy Data Quality Objectives

DEFT Results: Routine to Concern Level

Probably of Deciding that True
Mean is Greater than the Criterion

Estimated Performance Curve

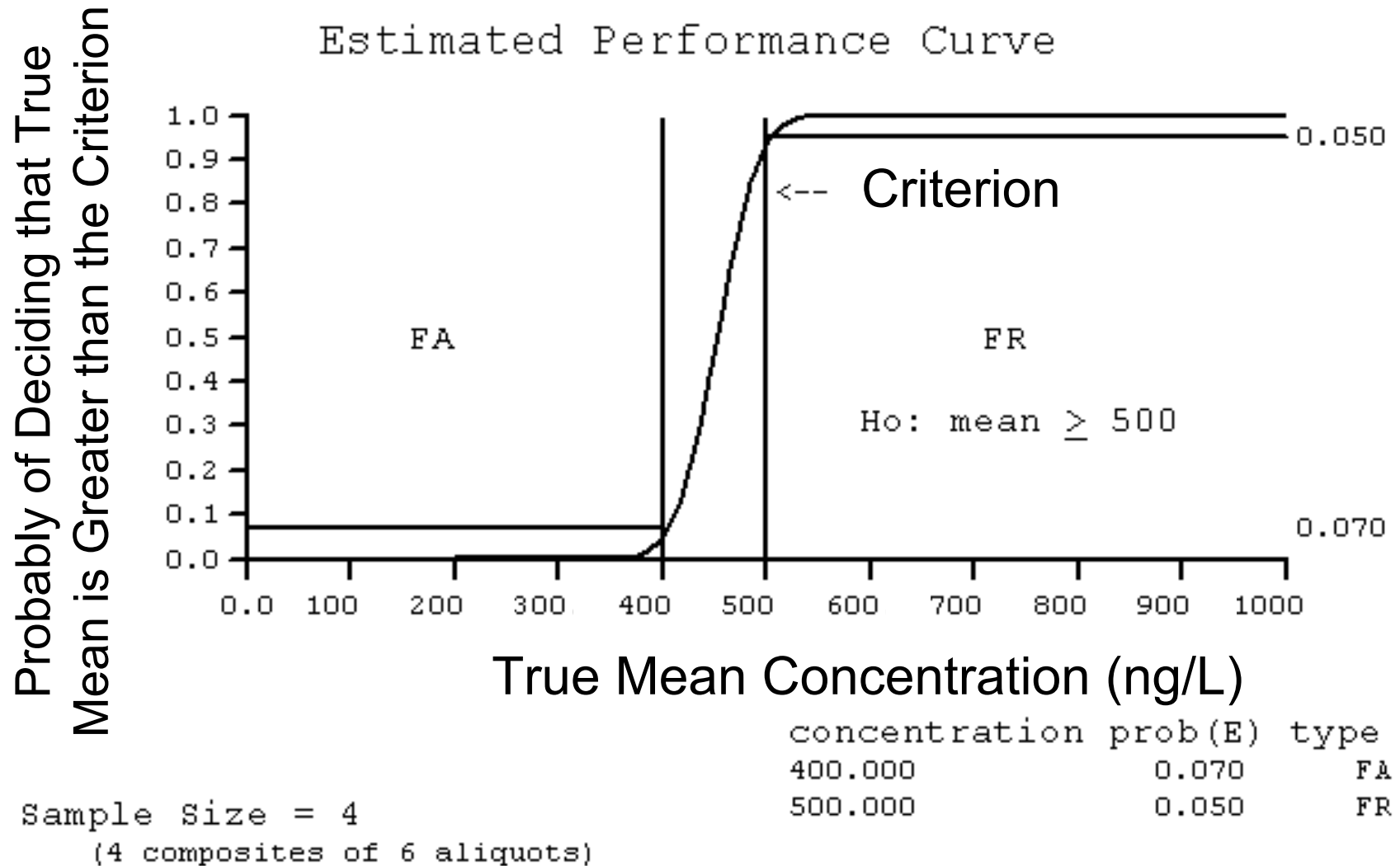


Sample Size = 7

concentration	prob(E)	type
600.000	0.250	FR
700.000	0.150	FA

DEFT Results:

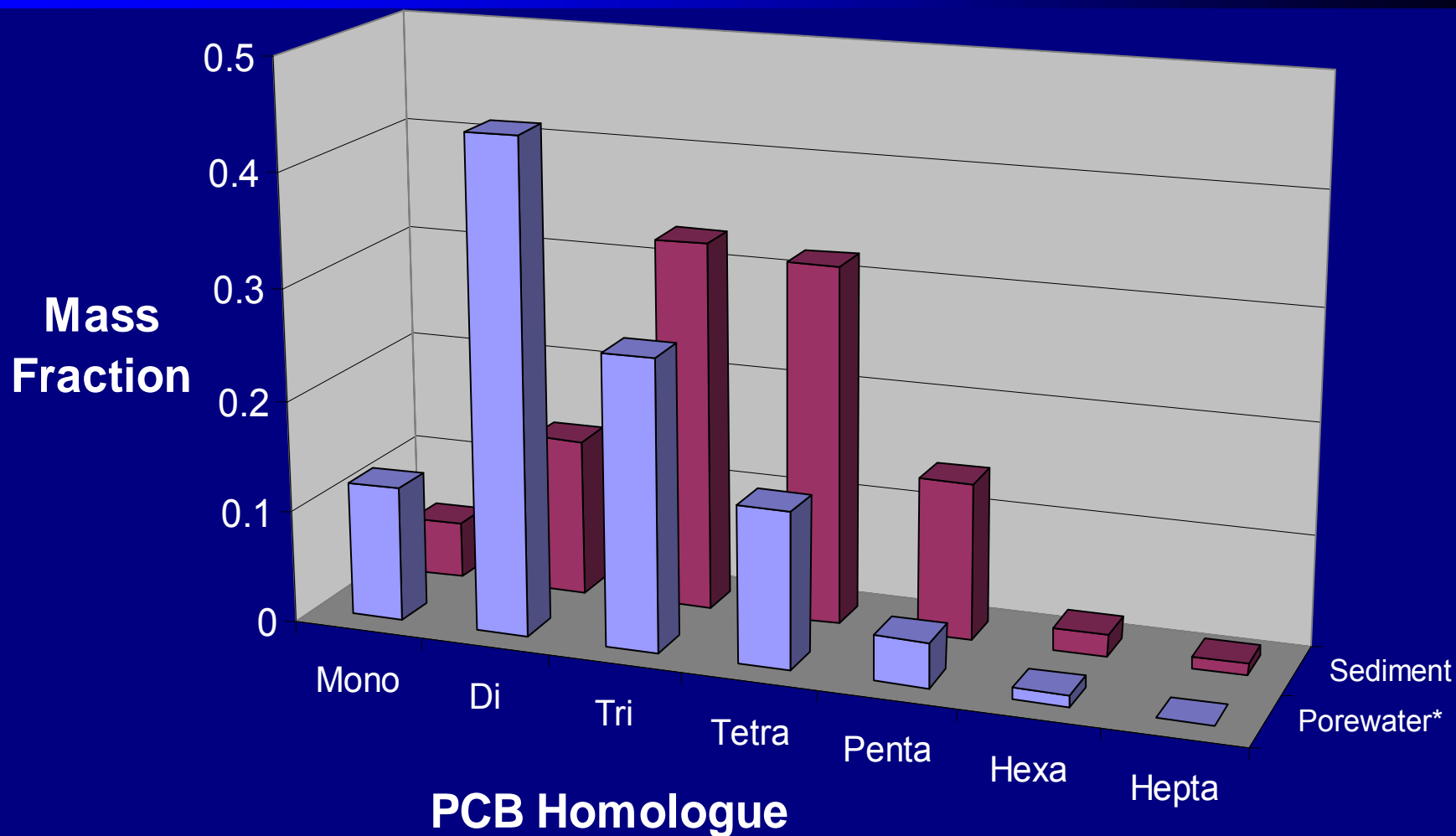
Confirmation of 500 ng/L Exceedence



PCB Concentrations on a Congener-Specific Basis

- **Method Sensitivity (<10 ng/L)**
- **Comparability with Historical Records**
- **PCB Source Assessment**
 - Dissolved vs. Suspended Releases

Congener Patterns in the Upper Hudson



Engineering Evaluation

- Studies to determine the nature of PCB releases.
 - Performed when conditions are sufficiently above baseline to warrant further investigation
- Likely to involve additional measurements of TSS and PCB above those required by the standard in the vicinity of the remedial operations
 - Standard requirements represent absolute minimum investigation
- Evaluation is specific to the conditions observed and cannot be specified ahead of time
- Required for the Concern Level, the Control Level and the Standard Threshold
- Recommended for the Evaluation Level

Engineering Contingencies

Pro-Active Response Framework

Action Level	Monitoring Contingencies Required	Engineering Evaluation Required	Engineering Contingencies Required
Evaluation	Yes	Recommended	No
Concern	Yes	Yes	No
Control	Yes	Yes	Yes
Resuspension Standard Threshold	Yes	Yes	Yes (Temporary Halting of Operations)

Reverting to Lower Action Levels

- Evaluation or Concern Level
(7-day average load)
 - 1 week below action level.
- Concern Level Concentration
 - 2 days below action level
- Control Level (4-week averages)
 - 15 days below action level

Reverting to Lower Action Levels (cont'd)

- Resuspension Standard Threshold
 - Temporary halt operations
 - Modification of the remedial operation
 - Control Level monitoring
 - unless otherwise instructed by USEPA
- Lower Hudson
 - Below 350 ng/L Total PCB at Waterford for at least 2 days
- Suspended solids
 - Below action level for 1 day

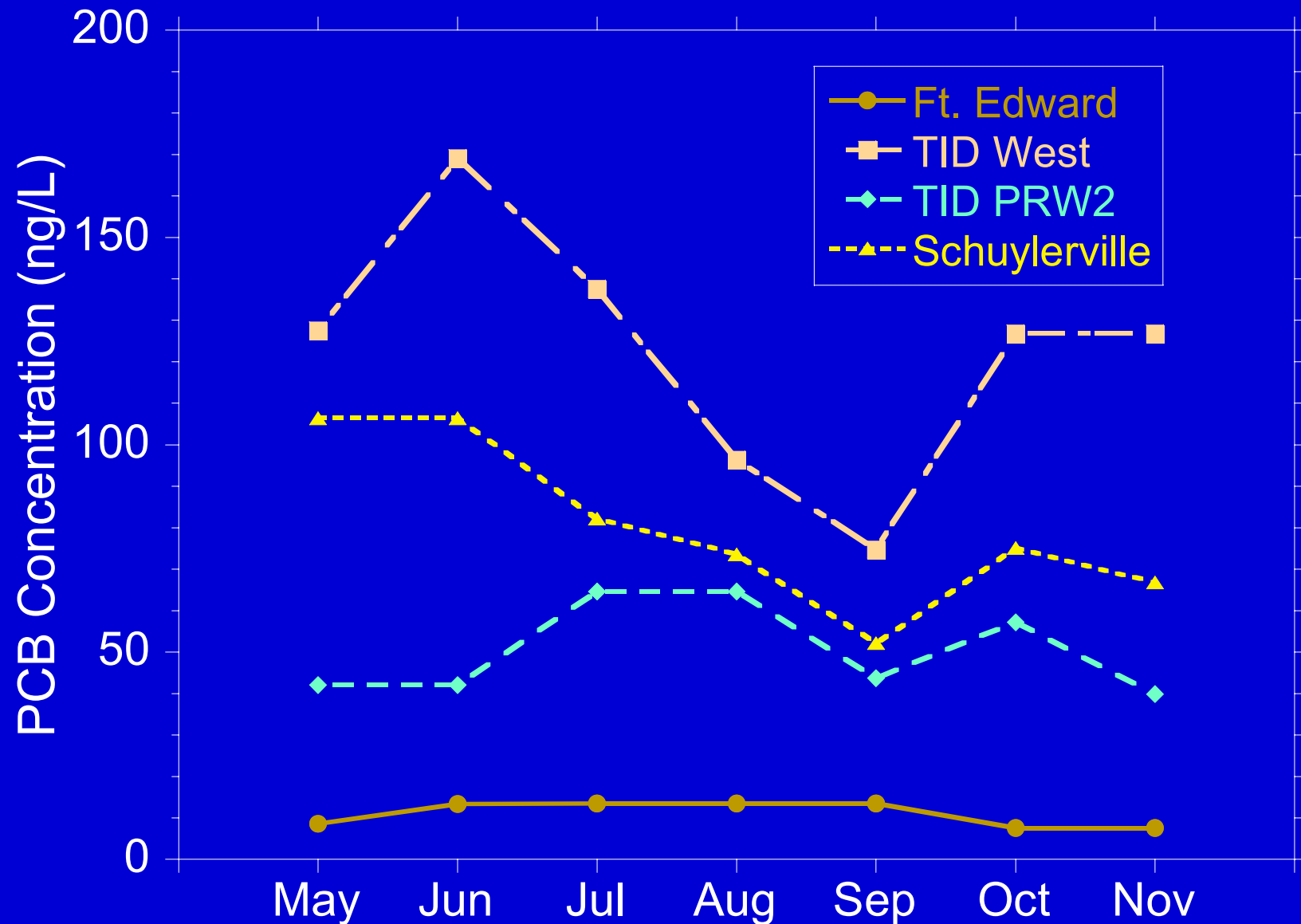
Supporting Analyses

- Assessment of Baseline Conditions
- Selection of Action Level Criteria
- Selection of the Resuspension Standard Threshold
- Case Studies

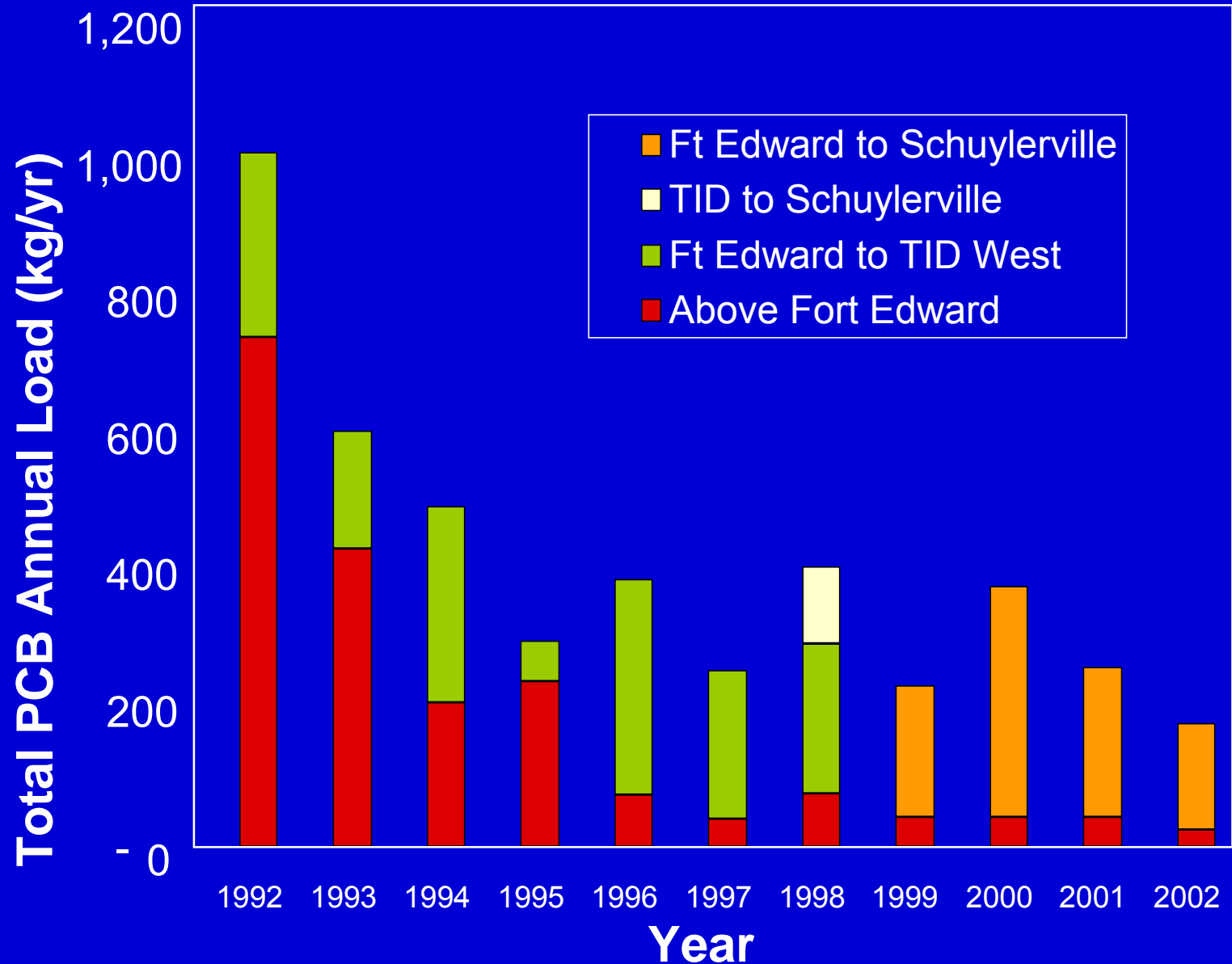
Baseline Conditions

- Existing PCB Concentrations
- Existing TSS Concentrations
- Relationships to Time and Flow

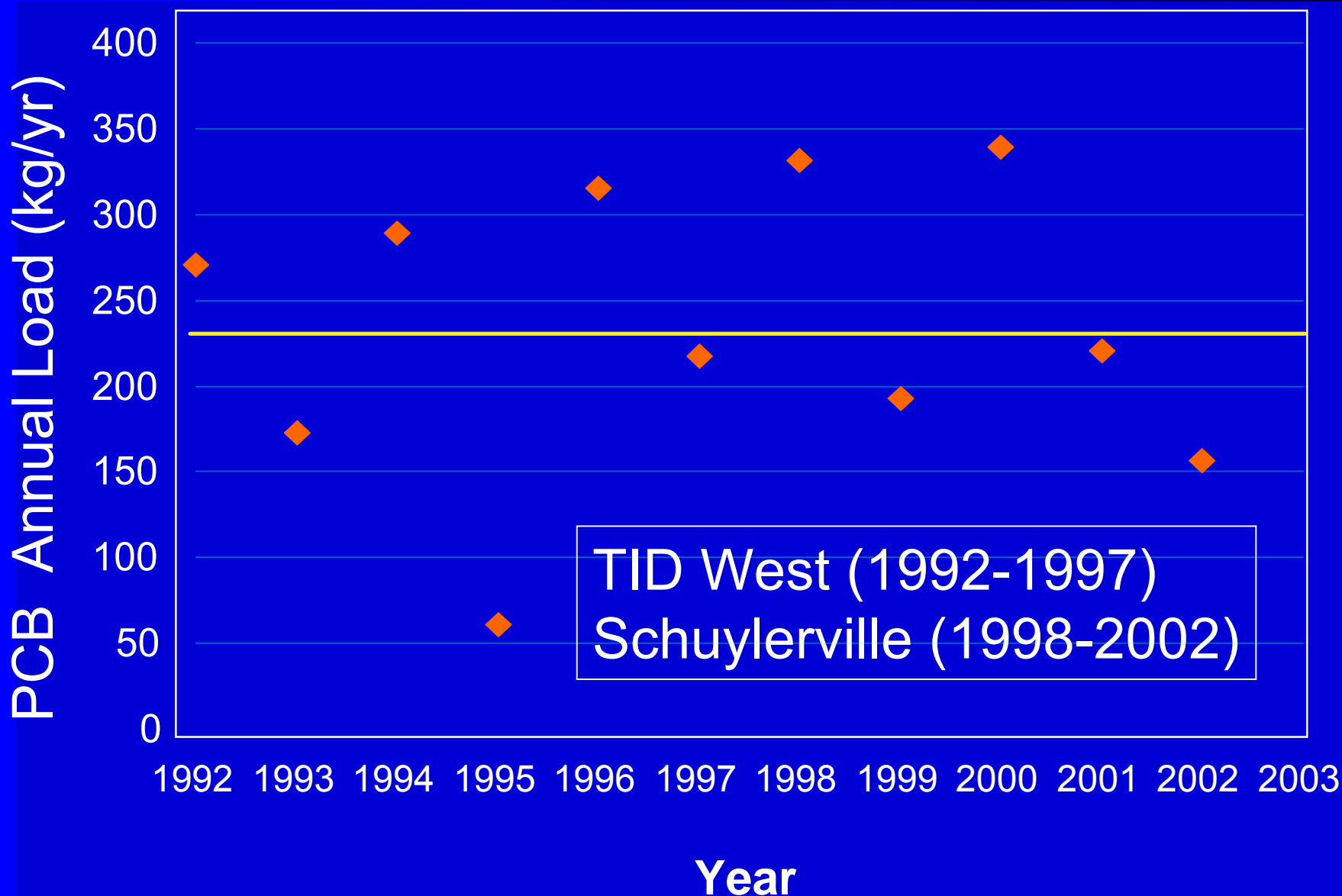
PCB Variation by Month



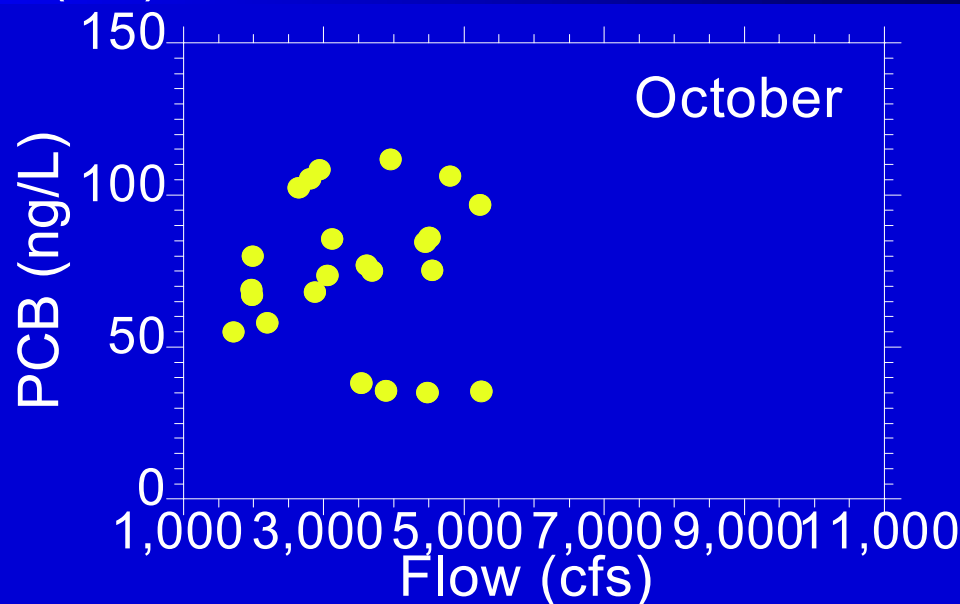
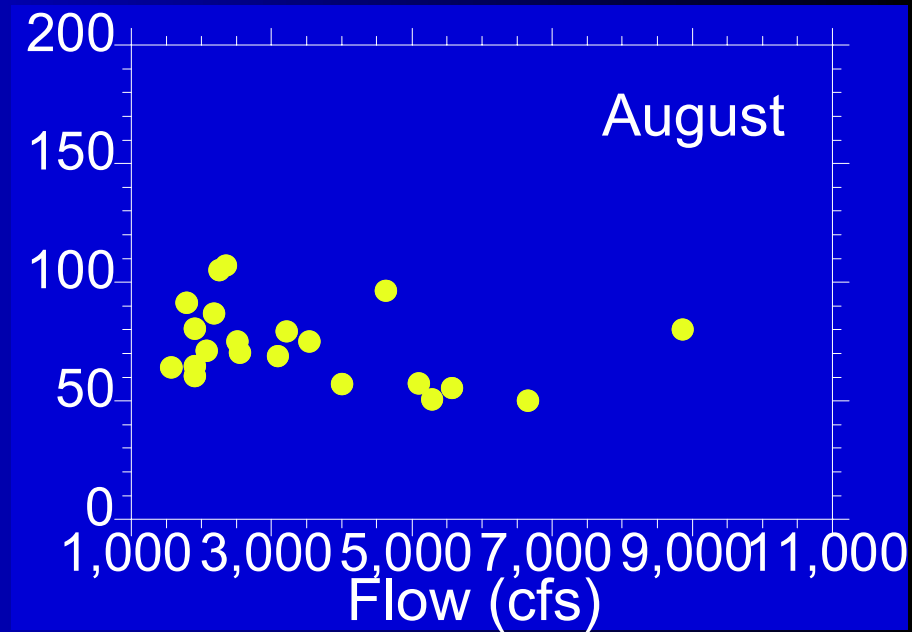
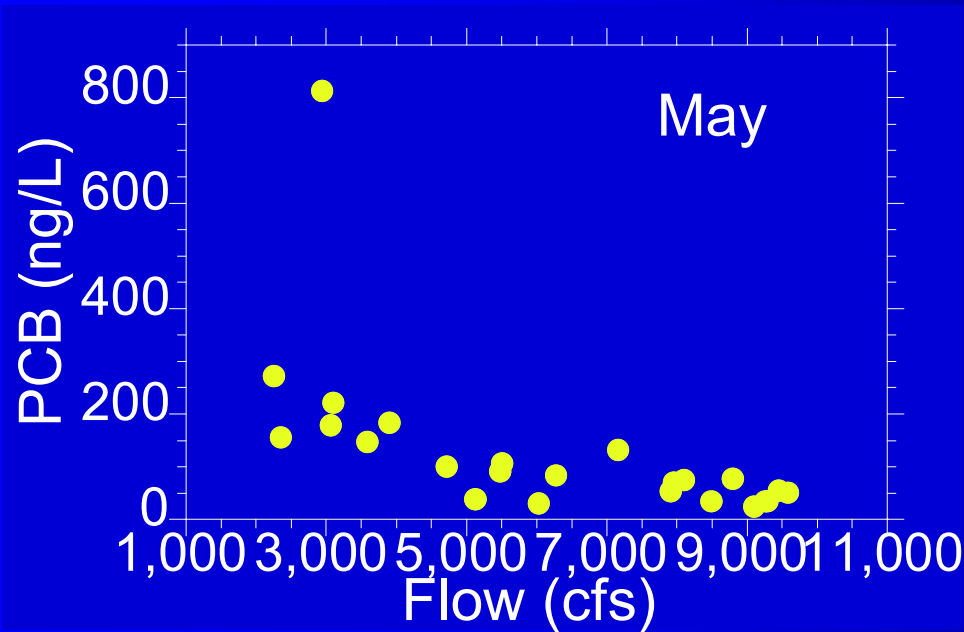
Historical Upper Hudson PCB Loads



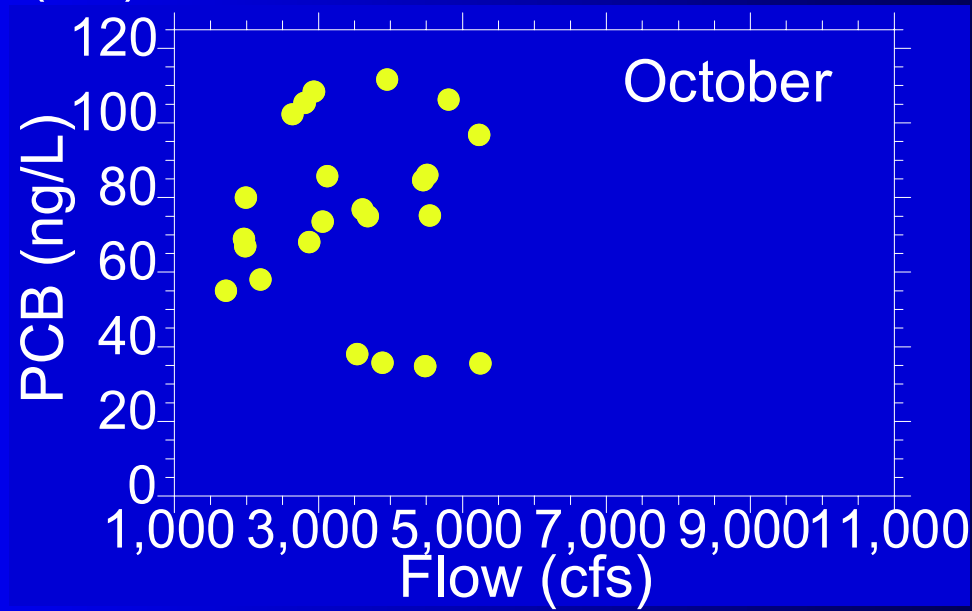
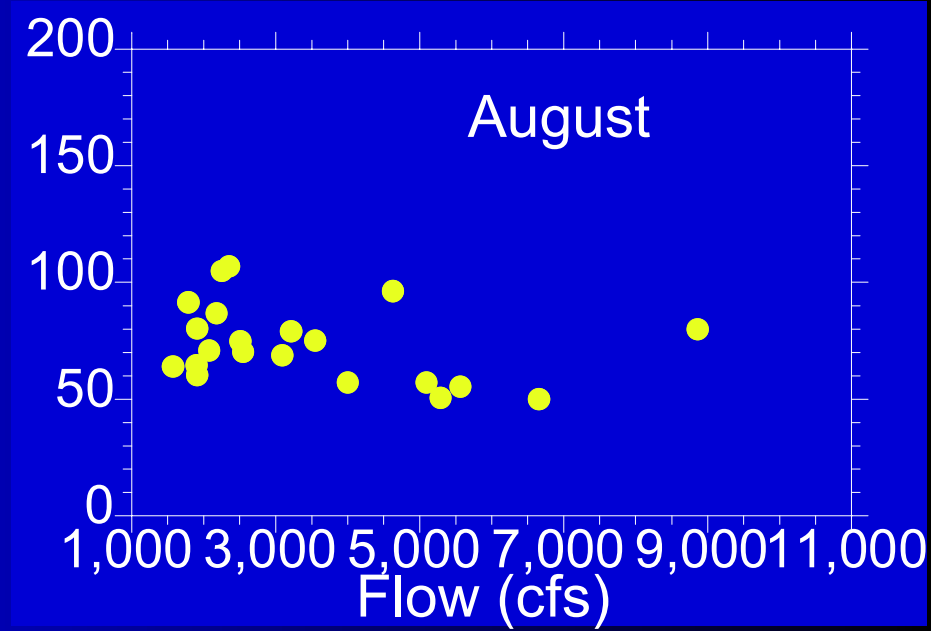
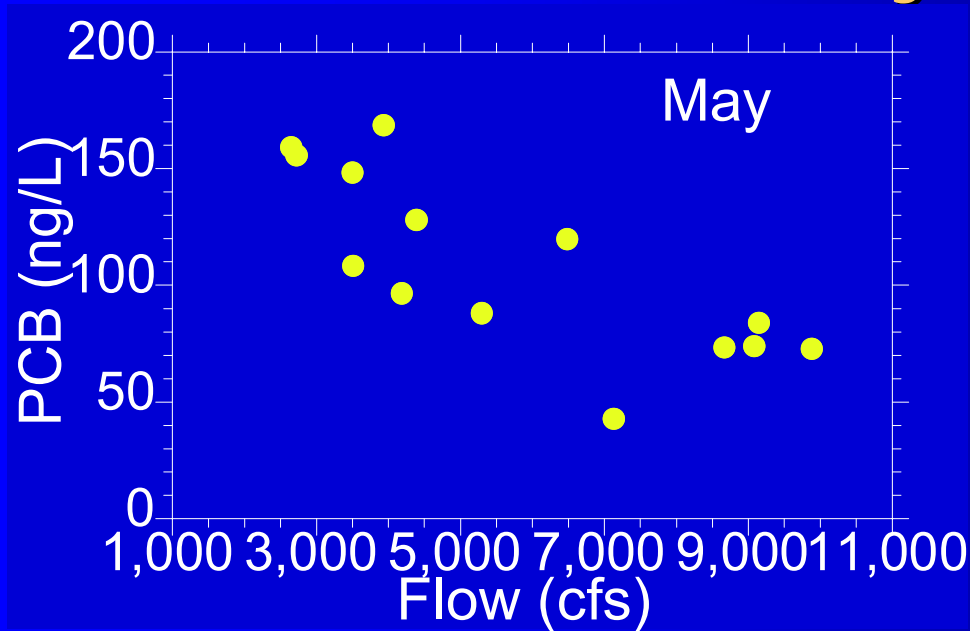
PCB Load Gain from the Sediments



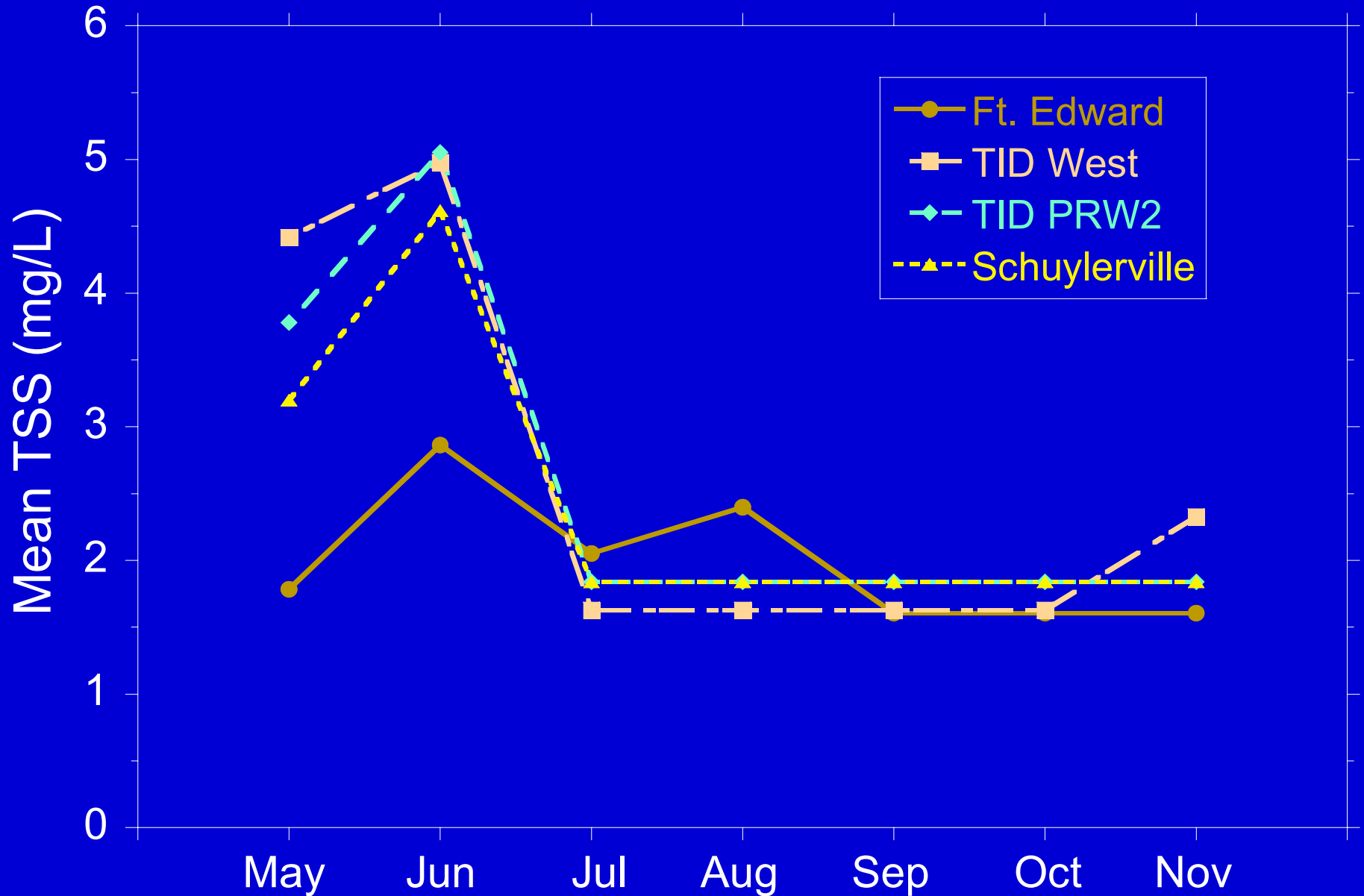
PCB vs. flow for various months at TID West



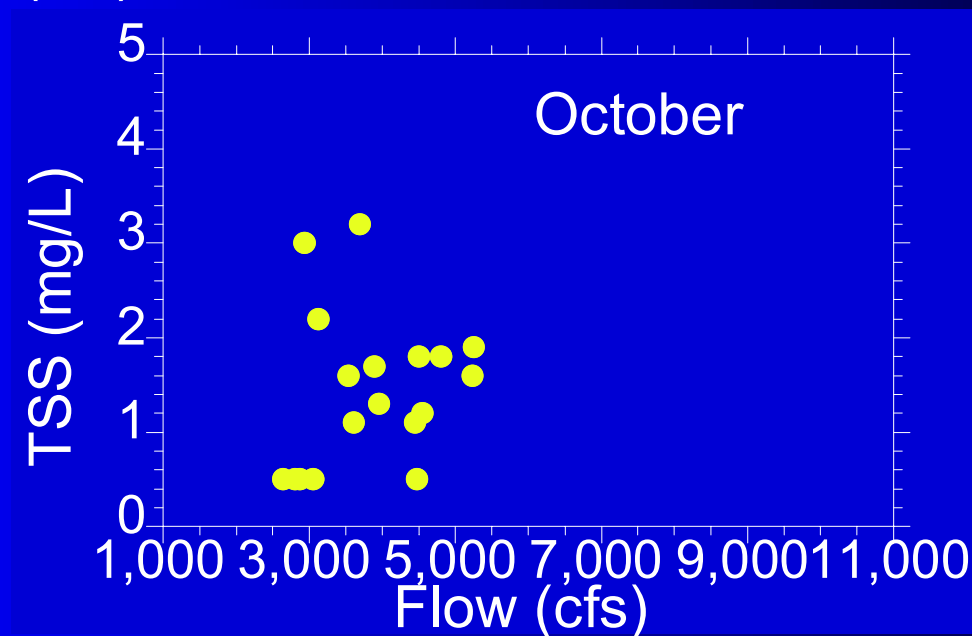
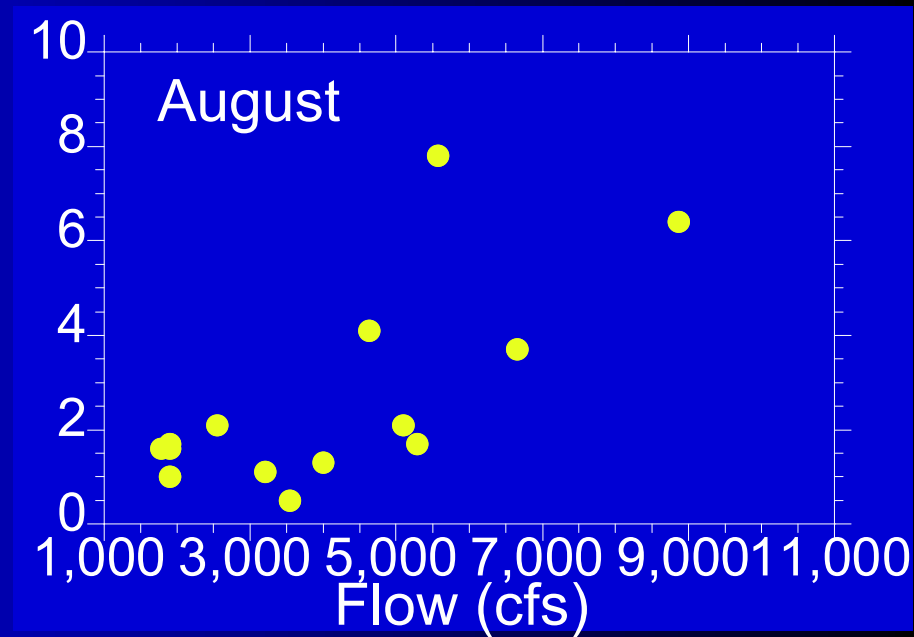
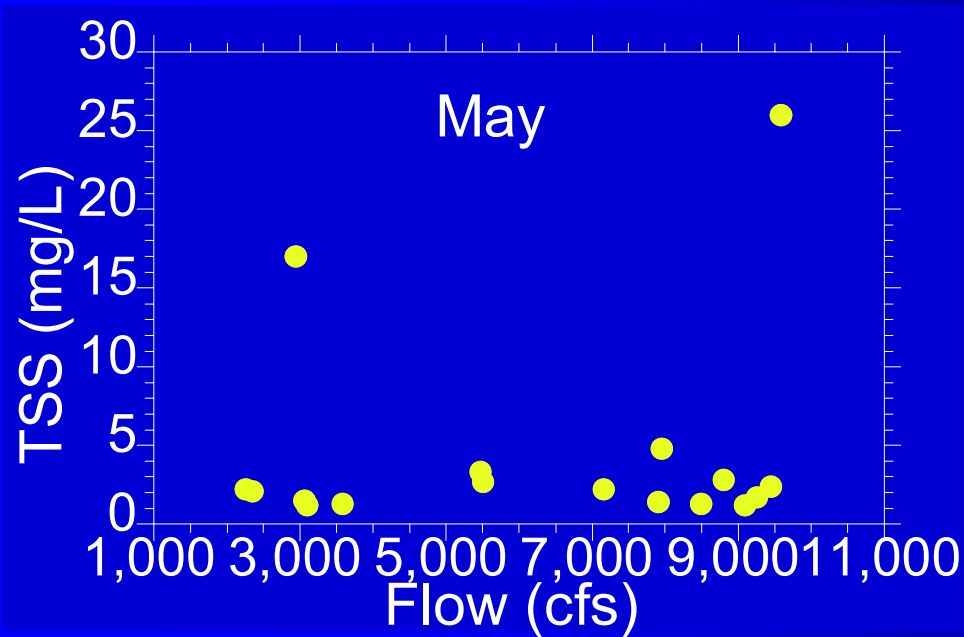
PCB vs. flow for various months at Schuylerville



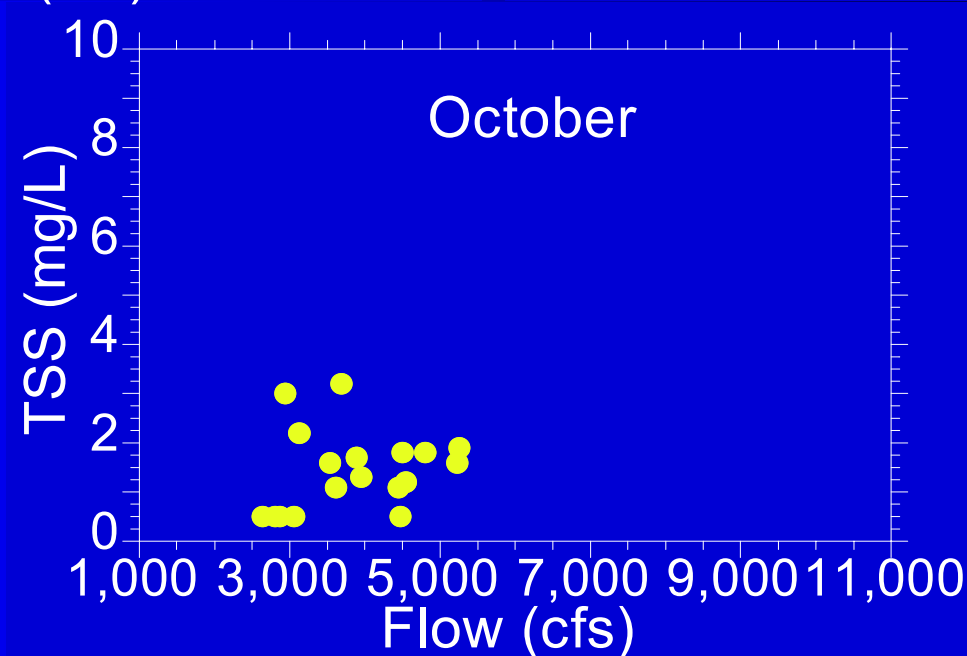
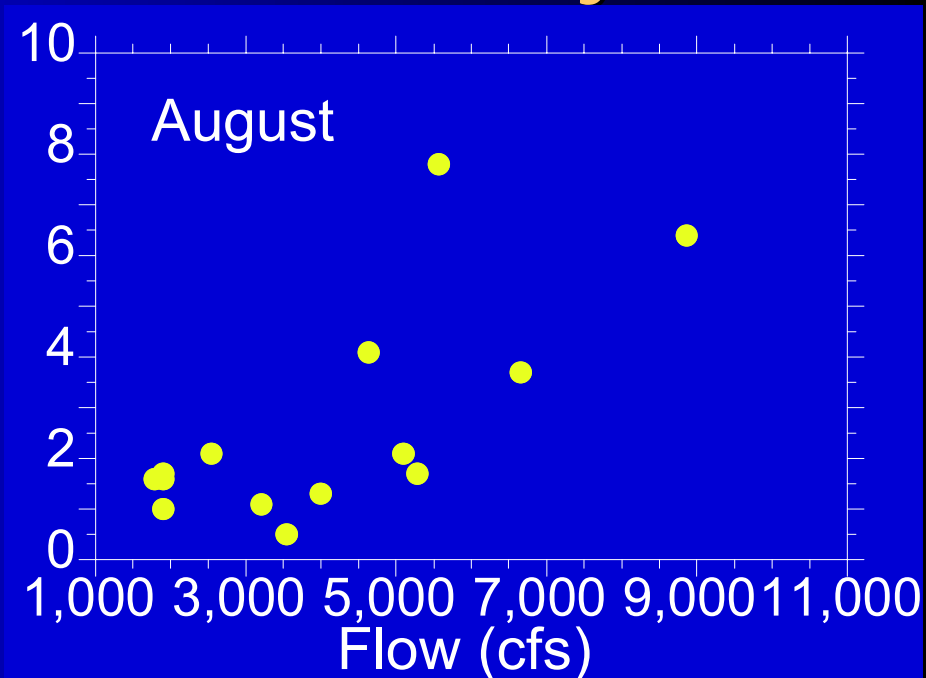
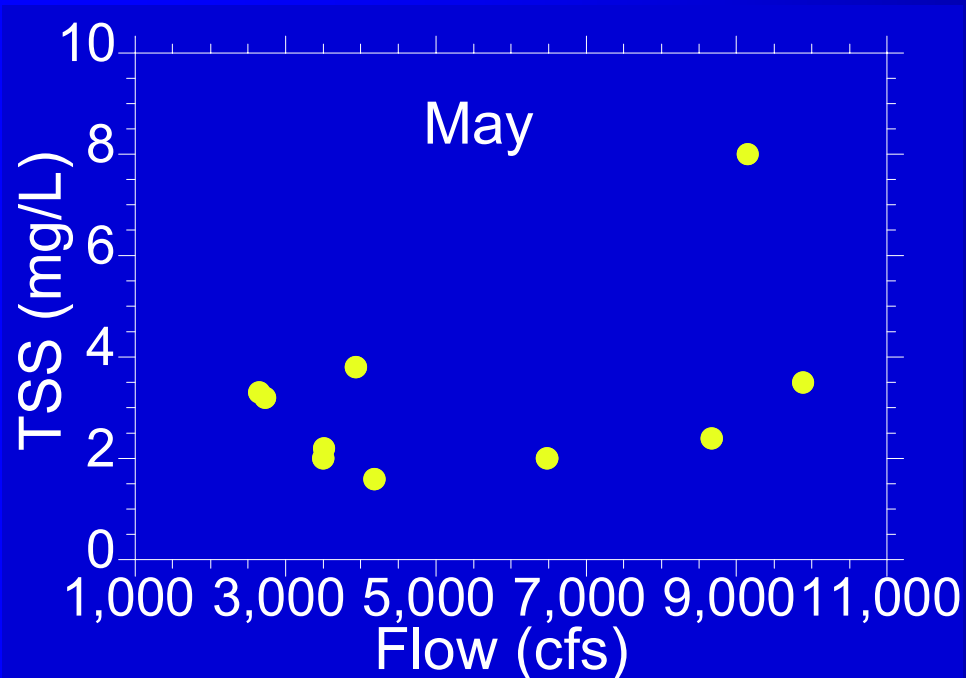
Mean TSS Value from May to November



TSS vs. Flow for Various Months at TID West



TSS vs. Flow for Various Months at Schuylerville



Baseline Condition Summary

- PCB concentrations show little correlation with flow but are seasonally variable
- Annual load from the sediments is 200+ kg/yr
- TSS can be approximated on a monthly basis as well

Action Level Considerations - Part 1

- Conservative engineering estimate of full scale production = 90 g/day Total PCB
 - **Dredging only**
- Baseline variability in concentration ≈ 40 ng/L or 300 g/day Total PCB at 3,000 cfs
- Average May-November daily load ≈ 700 g/day Total PCB

Action Level Considerations - Part 2

- Expected ratio of Total PCB to Tri+ in resuspended sediment is 3 to 1
- Tri+ PCBs are main focus for ecological and human risk
- Federal MCL for drinking water = 500 ng/L
Total PCB or 3,700 g/day at 3,000 cfs

Initial Resuspension Criteria

■ Evaluation Level

- 300 g/day Total PCB (7 day average)
- 100 g/day Tri+ PCB (7 day average)
 - first reliable detection of dredging-related releases

■ Resuspension Standard Threshold

- 500 ng/L Total PCB at any far-field station

Additional Resuspension Criteria

- **Concern Level (7 day average)**
 - PCB flux set at 2x Evaluation Level
 - This level is similar to baseline annual load variation
 - PCB concentration threshold set at 70 percent of MCL
- **Control Level (4 week average)**
 - Same as Concern Level only 4x as long
 - Also considers annual basis

Suspended Solids Considerations

- Dredging resuspension is not the only cause of high TSS
- Natural events and backfill operations will also cause elevated TSS
- High TSS is a likely necessary but not sufficient condition for PCB release
- High TSS events must be verified as a PCB release prior to any required change in operation
- Turbidity can serve as a real time measure of TSS

Suspended Solids Criteria

- **Evaluation Level (6 hour duration)**
 - Near-field TSS conditions (300 and 700 m) sufficient to cause 350 ng/L Total PCB at the far-field station
 - Far-field conditions sufficient to yield 500 ng/L Total PCB at the same station
- **Concern Level (All day to 24 hour duration)**
 - Near-field TSS conditions (300m only) sufficient to cause 350 ng/L Total PCB at the far-field station
 - Far-field conditions sufficient to yield 1,000 ng/L Total PCB at the same station

Suspended Solids Criteria (cont.)

- Exceedence of TSS criteria requires increased monitoring only
- No higher suspended solids criteria for Control Level or Resuspension Standard Threshold
- Engineering improvements are prompted by elevated PCB levels only

Criteria Development Summary

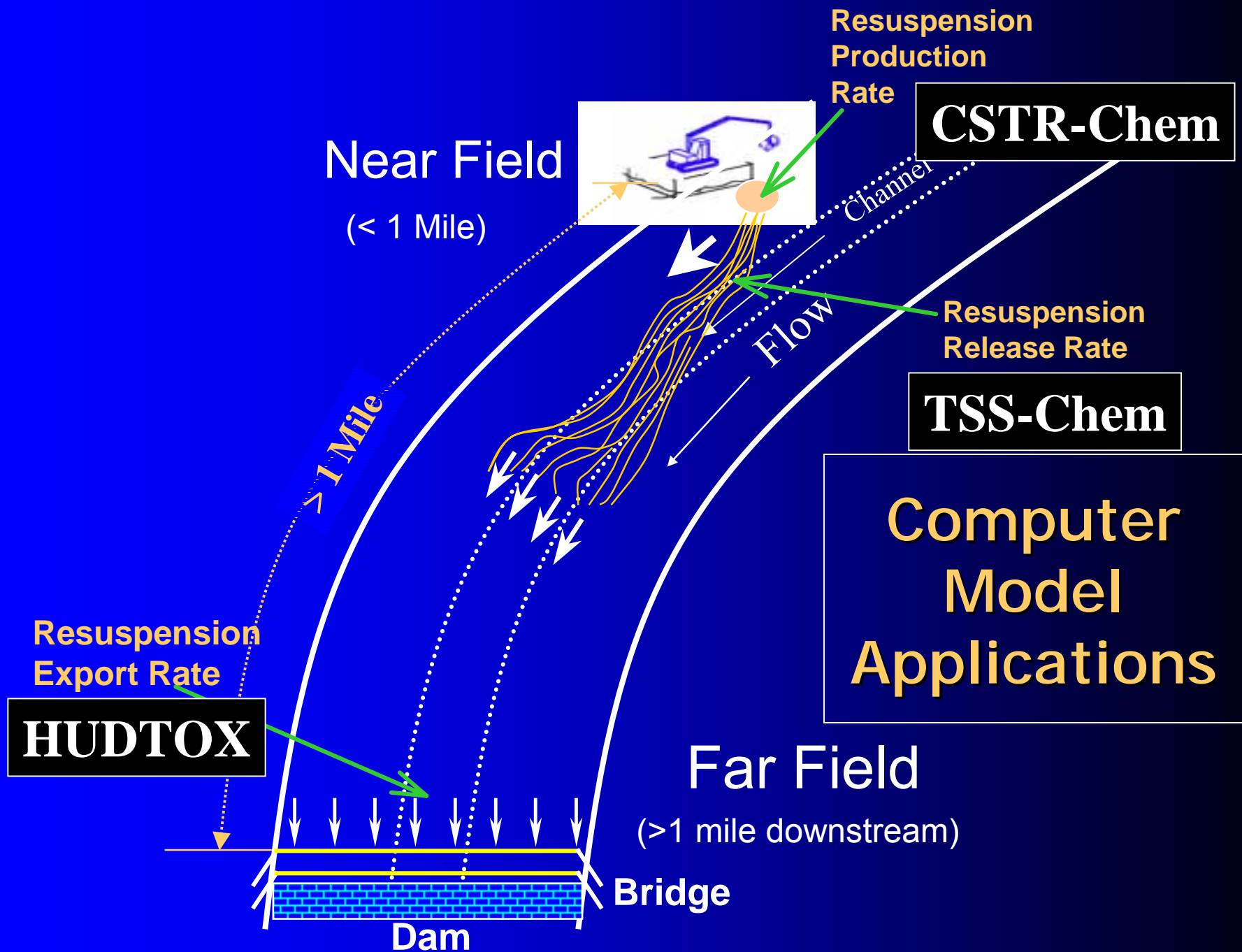
- **Criteria are based on:**
 - Existing Baseline Conditions
 - Best Engineering Estimates
 - Federal MCL
 - Pro-Active Response Framework
 - Incidents increase monitoring
 - Avoidance of “False Alarms”
 - PCB Level as the Ultimate Arbiter
- **Lower Action Levels Gather Data**
- **Upper Action Levels Confirm Compliance**

Impacts of Dredging-Related Releases

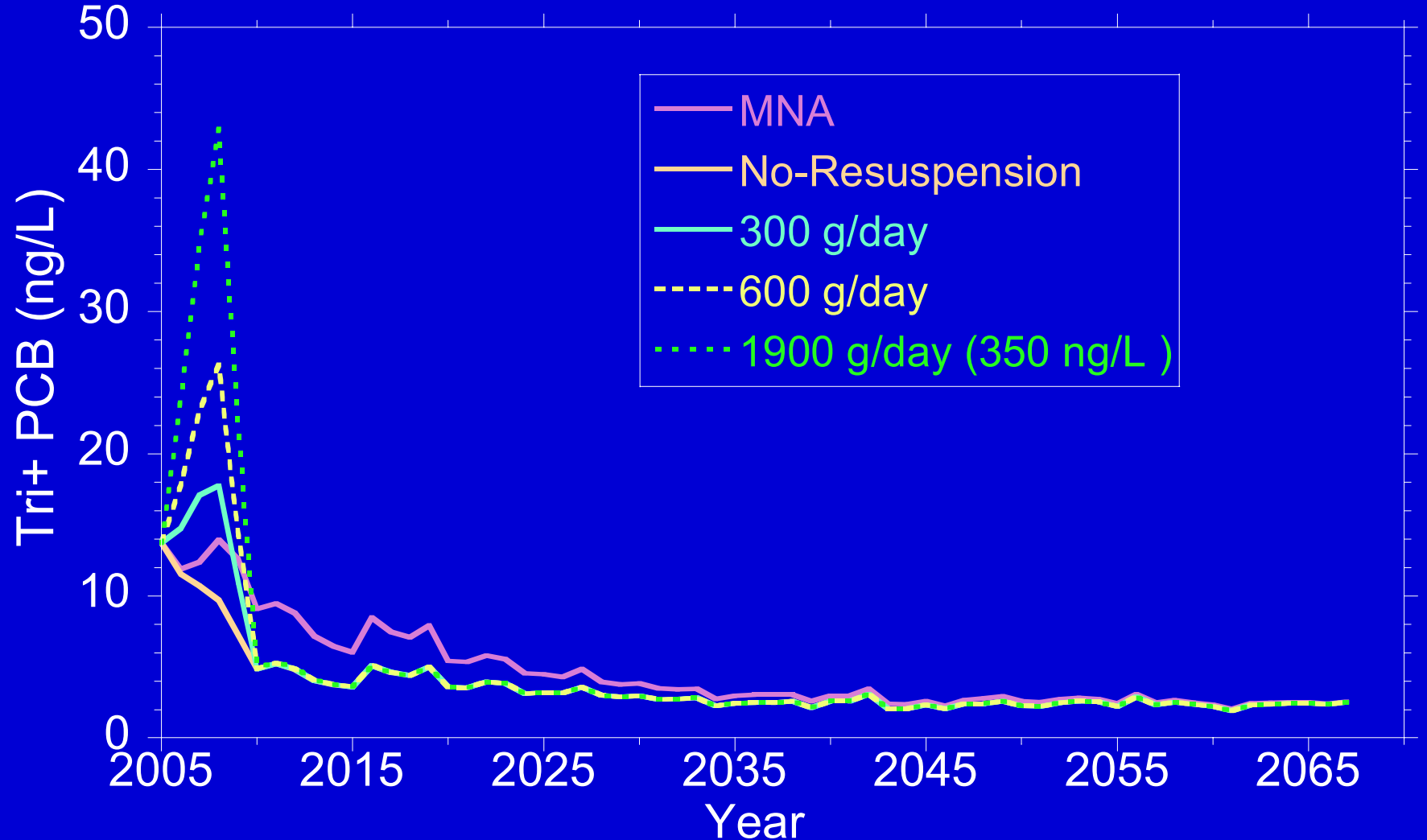
- **Model simulation**
- **Long range forecasts**

- **From the ROD:**

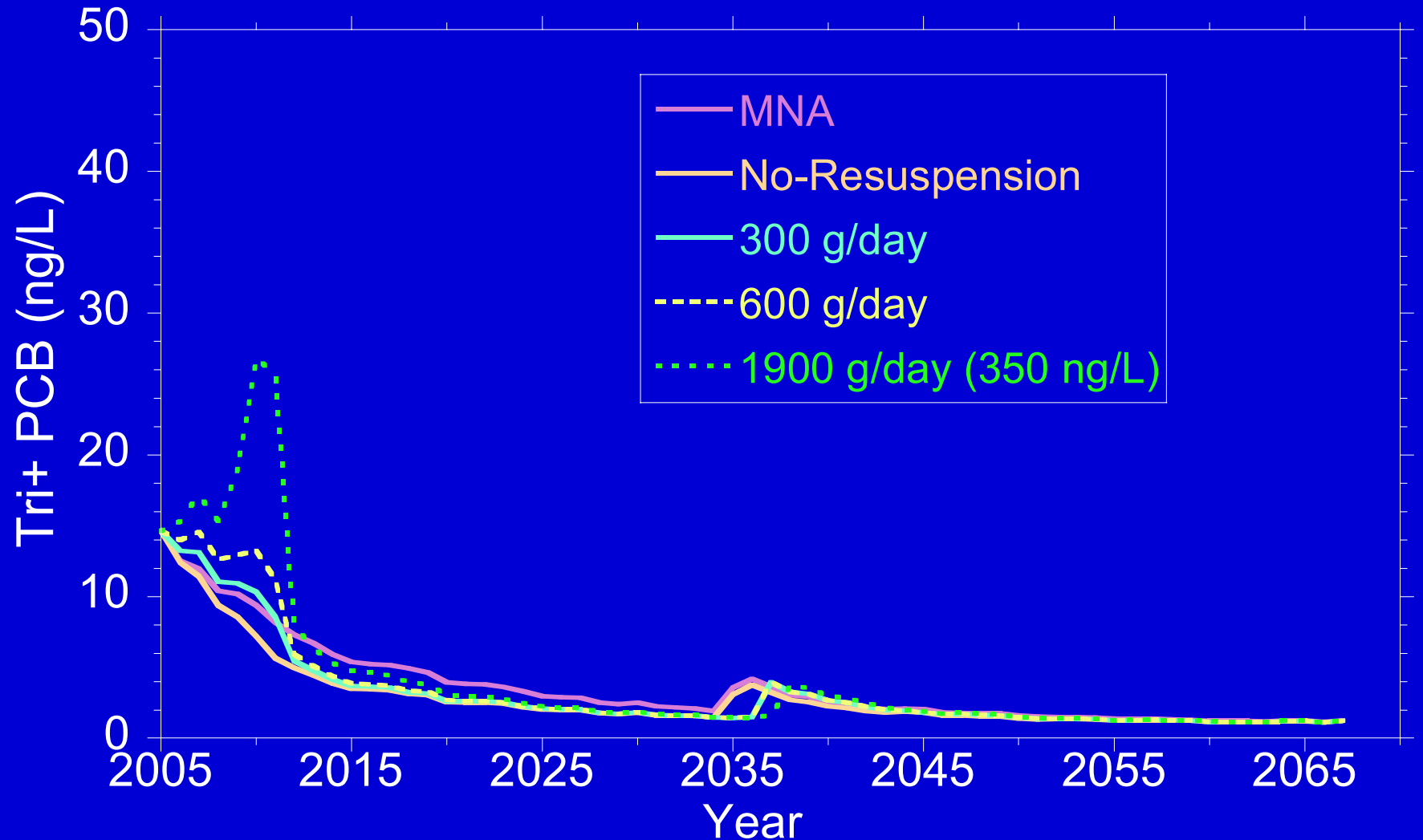
...Although precautions to minimize resuspension will be taken, it is likely that there will be a localized temporary increase in suspended PCB concentrations in the water column and possibly in fish PCB body burdens. (ROD § 11.5, page 85)



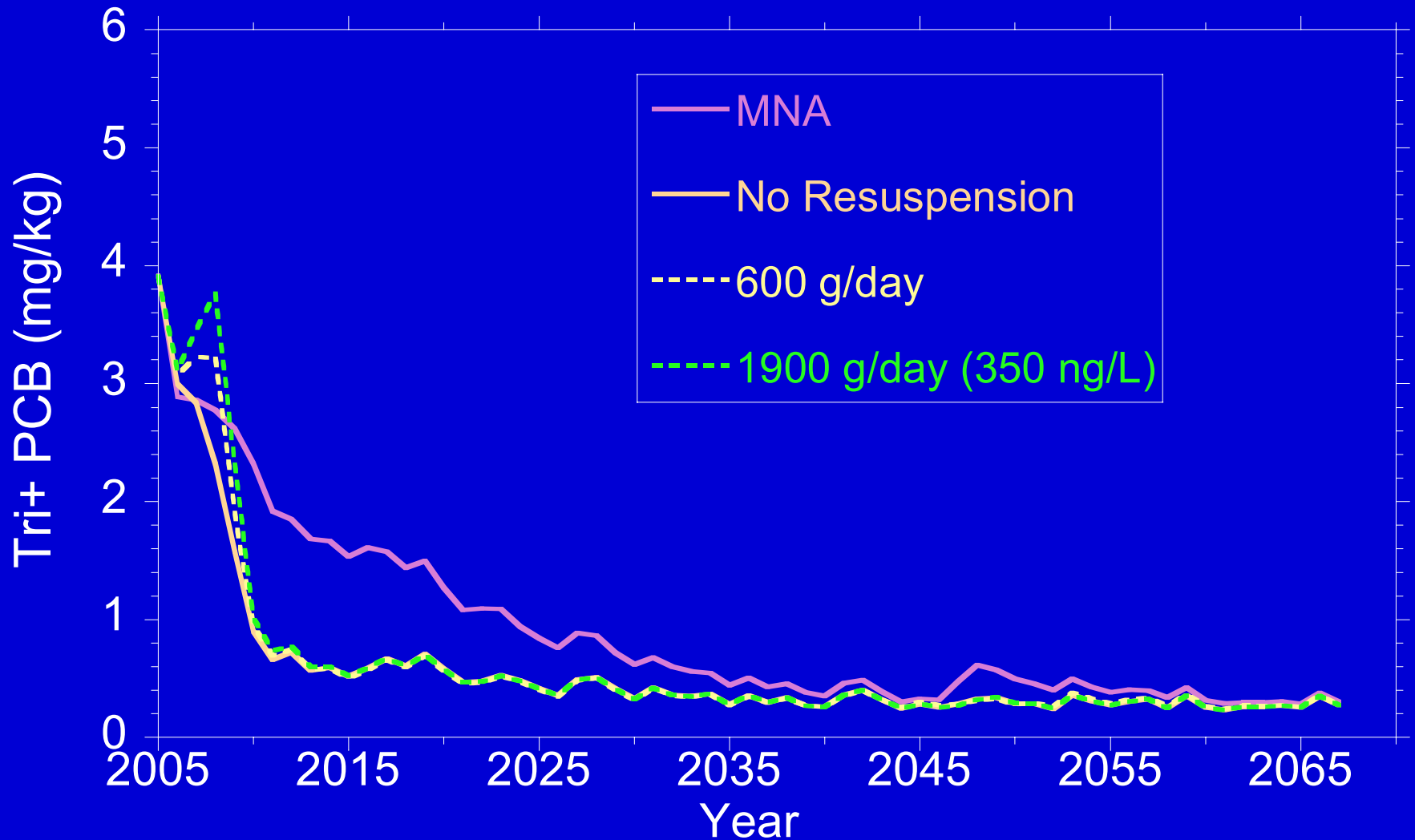
Post-Dredging Water Column Tri+ Concentrations at TI Dam Decline for All Criteria



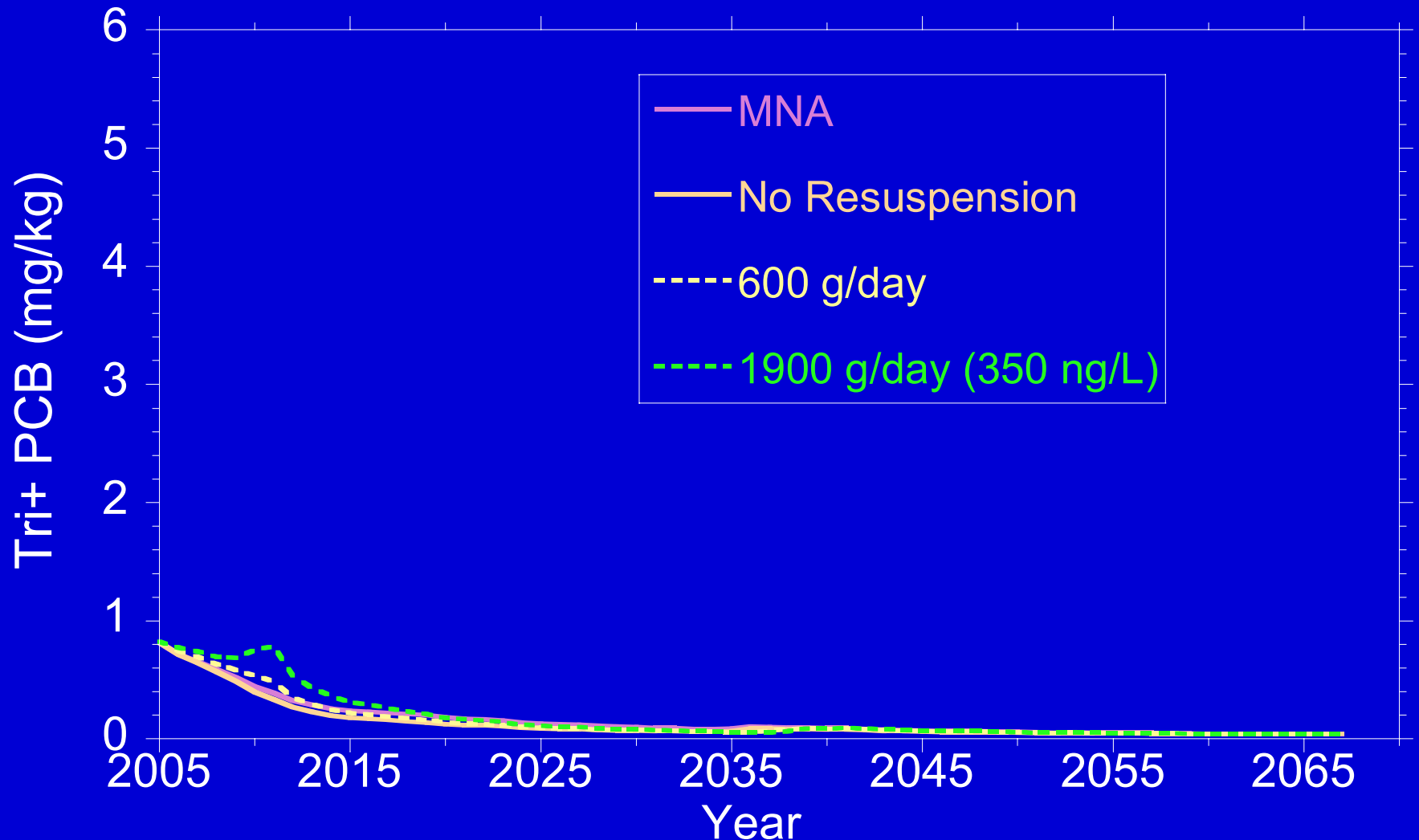
Post-Dredging Water Column Tri+ Concentrations at Waterford Decline for All Criteria



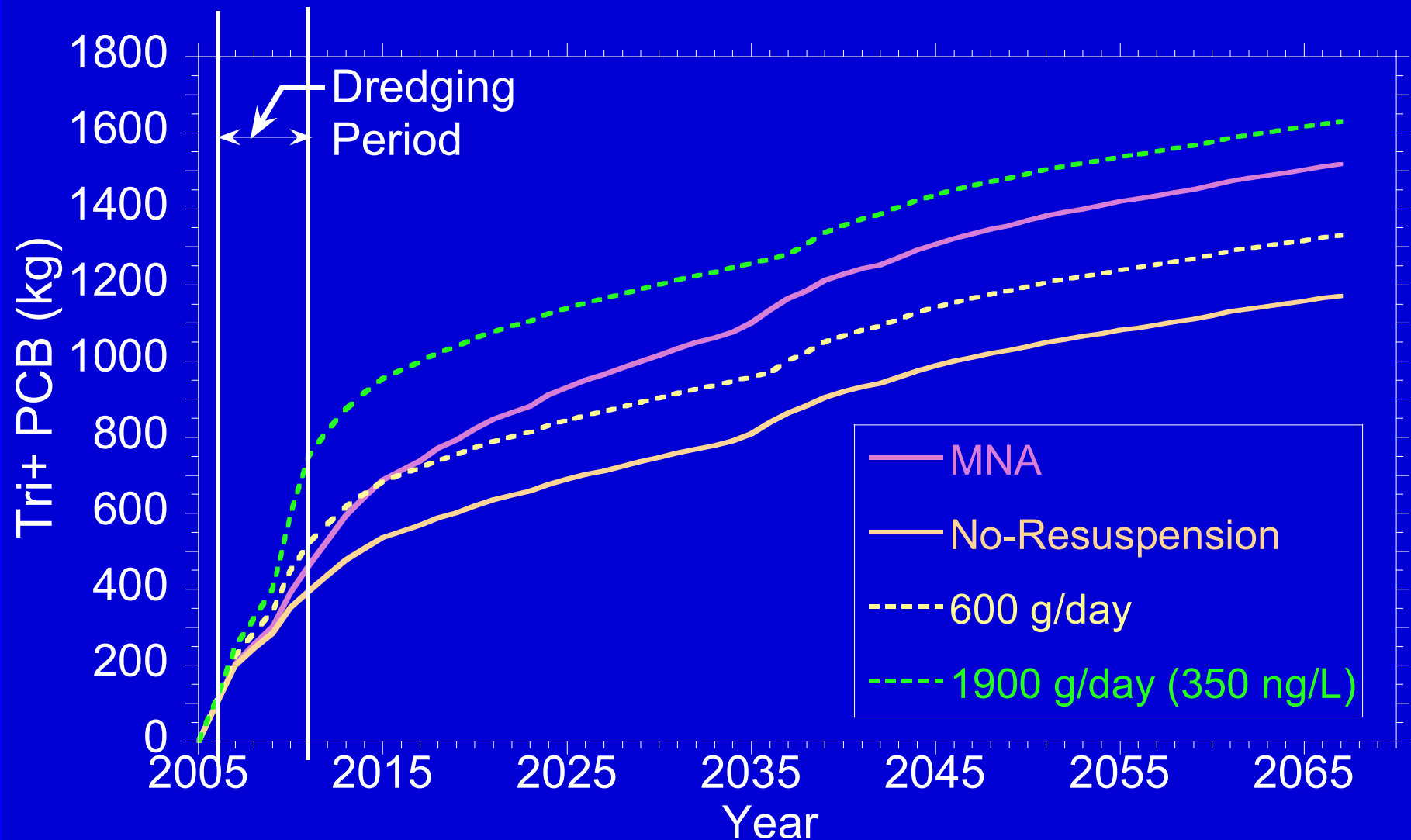
Post-Dredging Fish Tissue Concentrations Decline in TI Pool for All Criteria



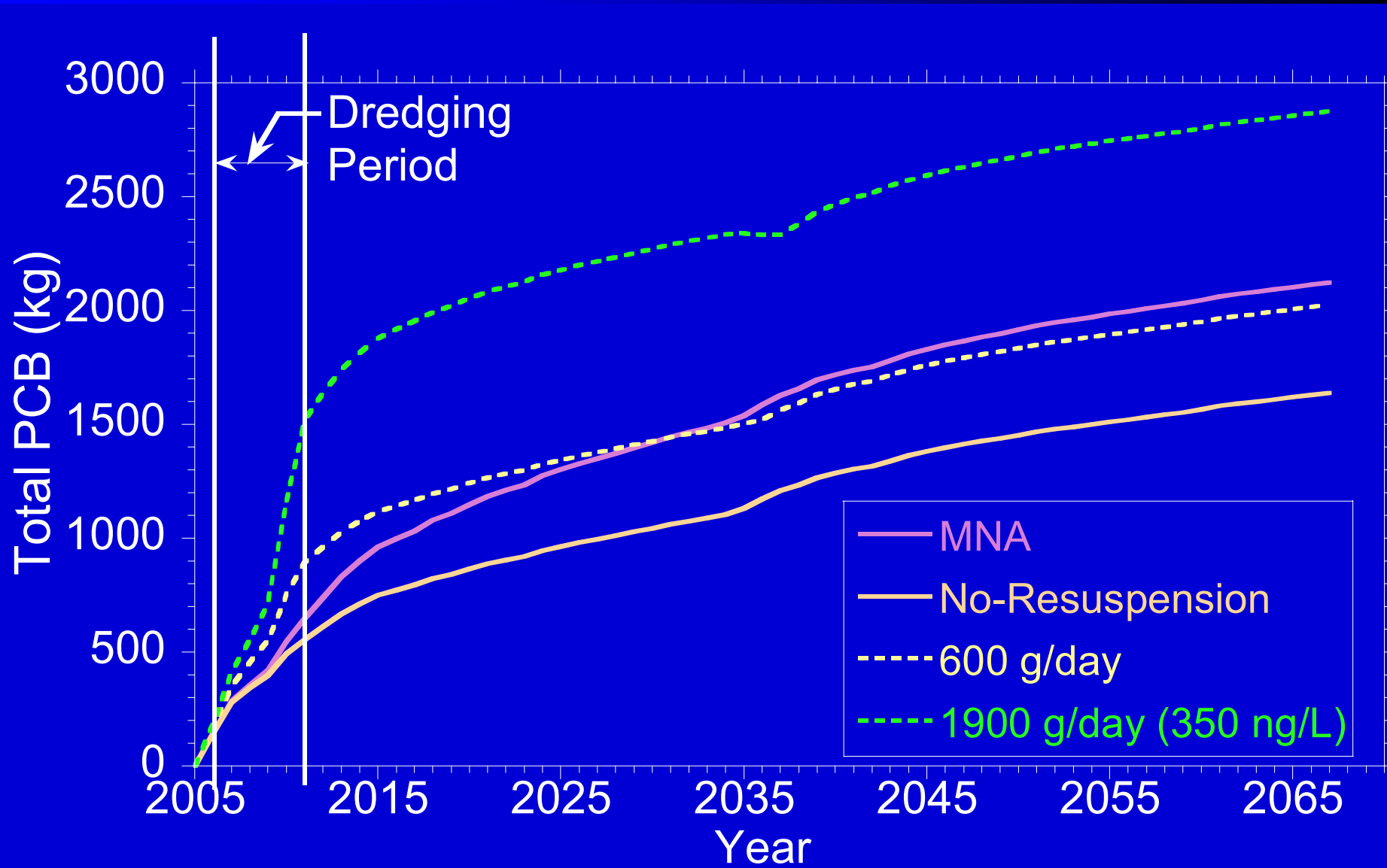
Post-Dredging Fish Tissue Concentrations Decline in River Section 3 for All Criteria



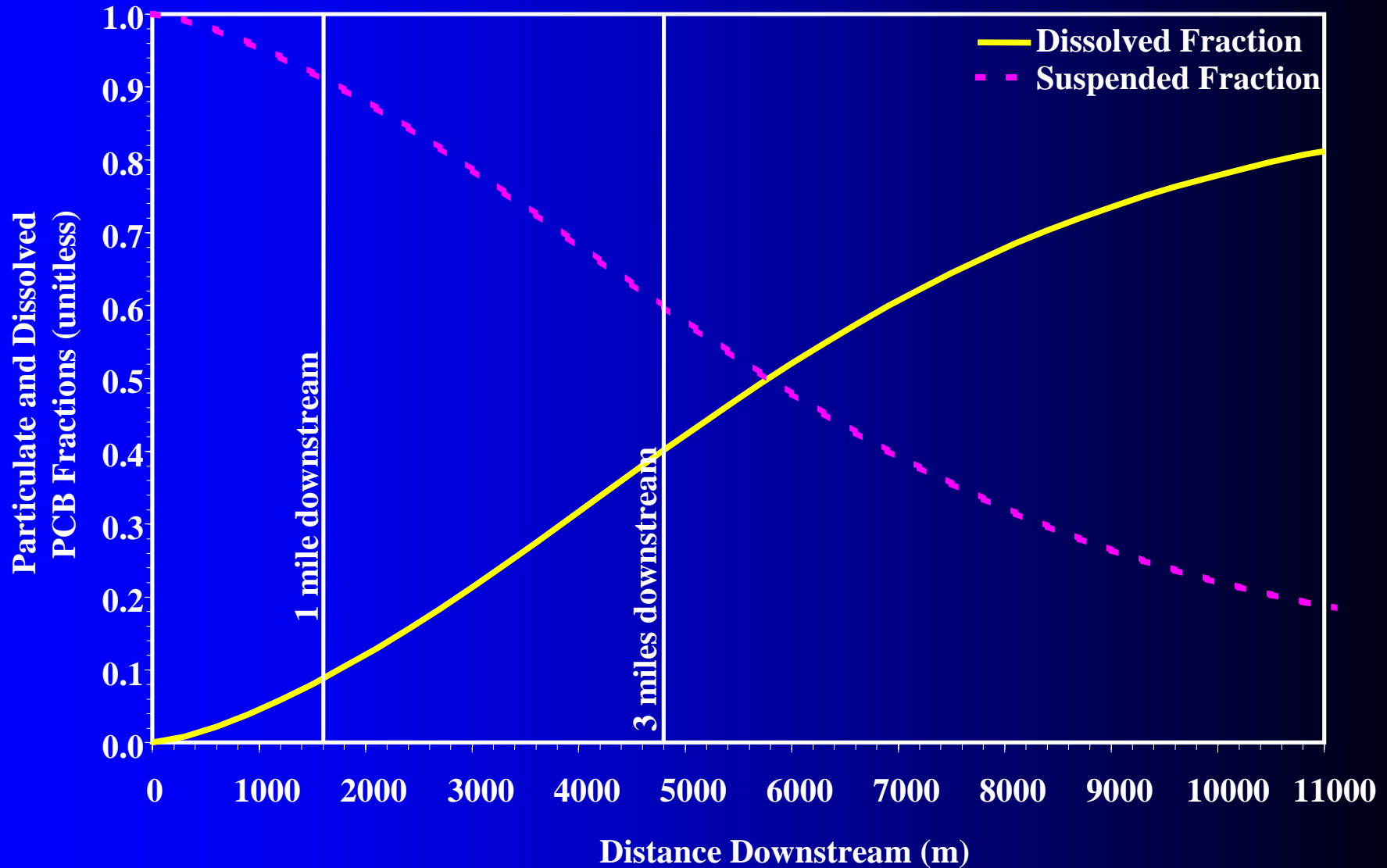
Resuspension Standard Releases Substantially Less Tri+ to the Lower Hudson



Total PCB Delivery to the Lower Hudson Will Be Less Than MNA

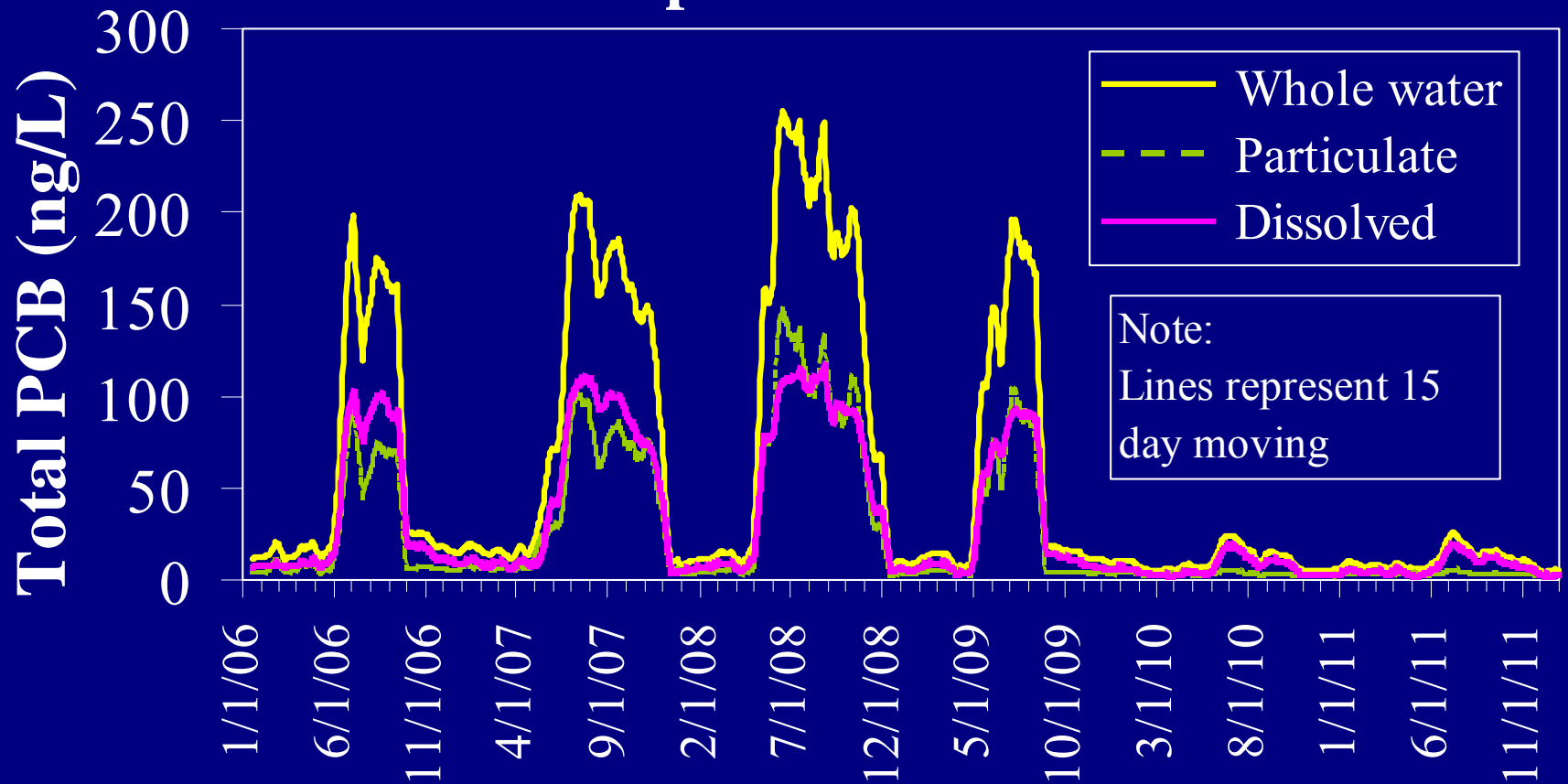


Model Shows Gradual PCB Dissolution Due to Dredging Resuspension



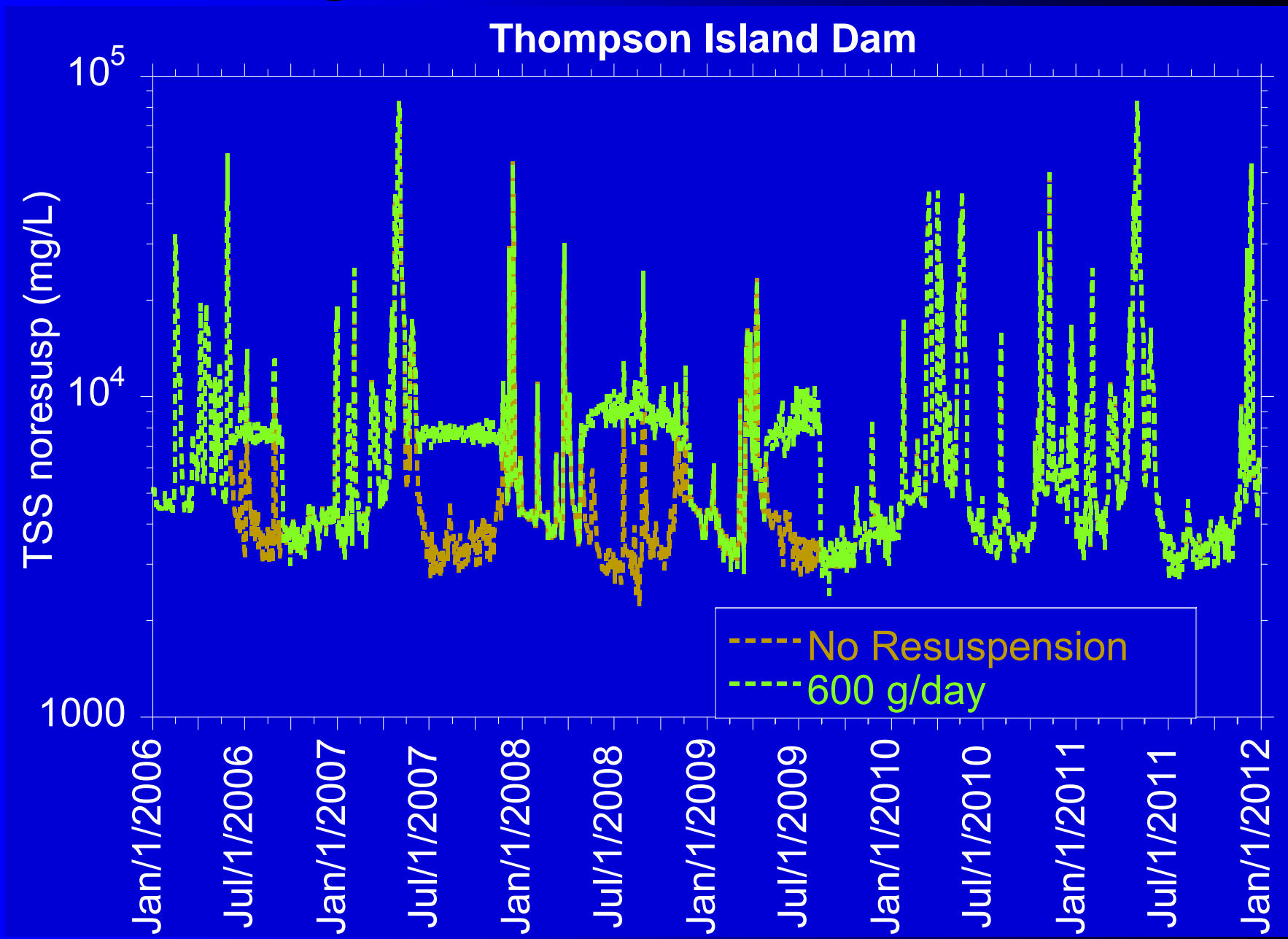
Model Output Shows Significant TSS Signal at Far-Field Stations

Thompson Island Dam



Control Level load sustained at 600 g/day
Total PCB Flux

TSS Signal at Far-Field Station



Modeling Summary

- No long-term effects for allowable releases under the Resuspension Standard
- PCB dissolution unlikely to create a hidden PCB signal
- TSS remains sufficiently elevated to detect substantive dredging resuspension

Case Studies

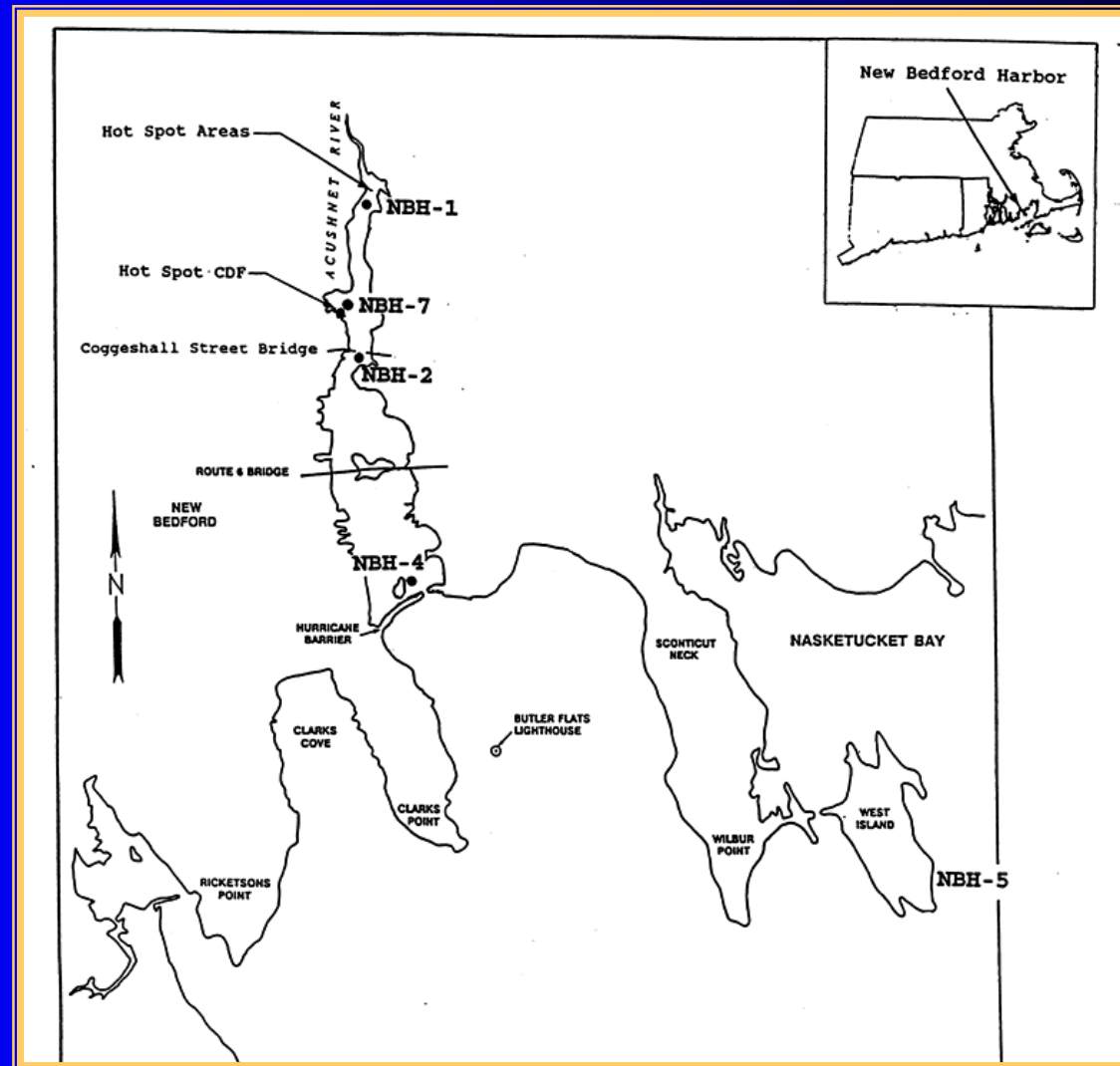
- Review of previous monitoring programs.
- PCBs and suspended solids (turbidity).
- Perspective on dredging related release.
- Techniques used to monitor dredging operations.

Case Study Sites

	New Bedford Harbor	Hudson Falls	Fox River (SMU 56/57)	Reynolds-Messina	GM-Messina
Duration and Year	18 months 1994-1995	7 months 1997 & 1998	4 months 1999	8 months 2001	8 months 1995
Volume (yd³)	14,300	~800	8,814	86,600	~14,000
PCB Mass (kg)	43,733	3,890	654	9,160	~60
Percent Export	0.36	0.12	2.2		

- Hudson Falls volume assumes 1.4 tons/cy (1,067 tons).
- Fox River volume assumes average concentration of 53 ppm and density of 1.4 tons/cy.
- GM PCB mass assumes average concentration of 3 ppm and density of 1.4 tons/cy.

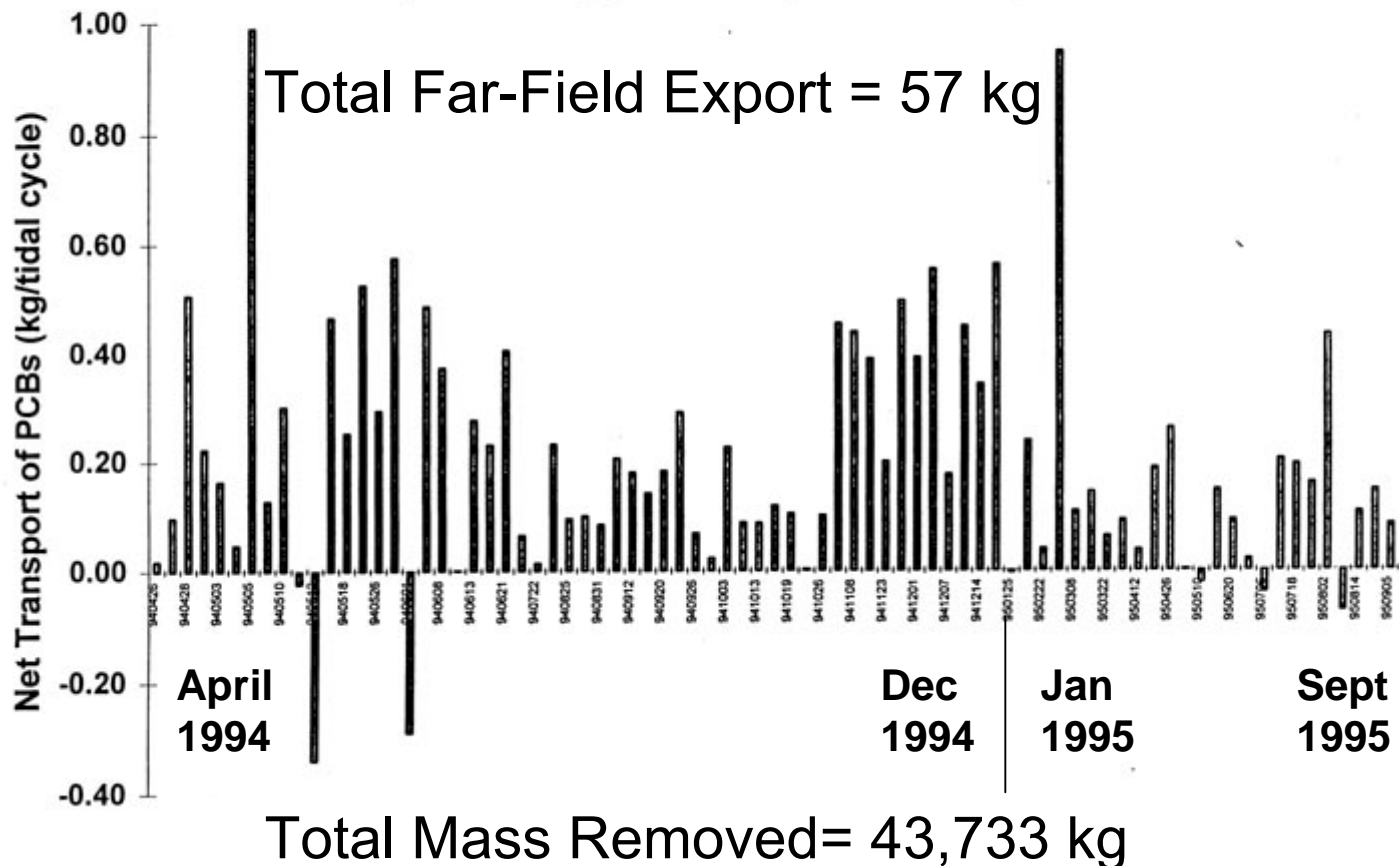
New Bedford Harbor Hot Spot Remediation Monitoring



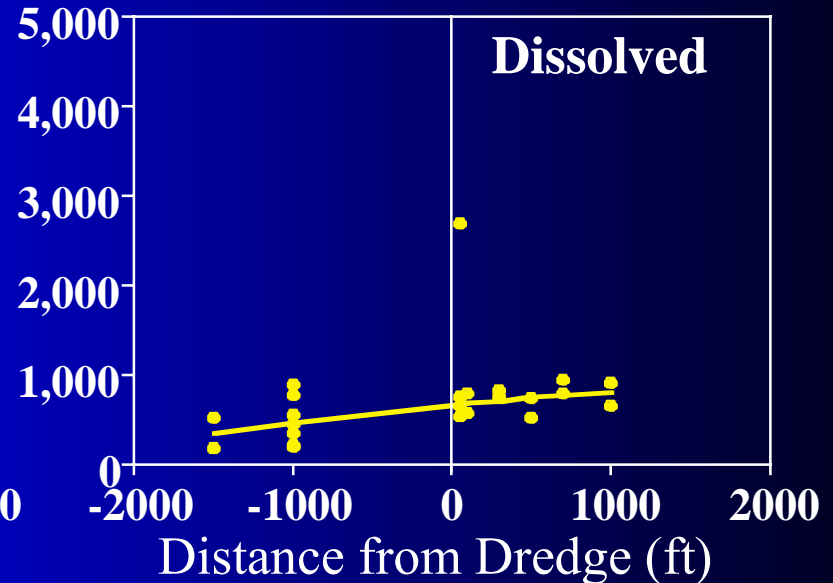
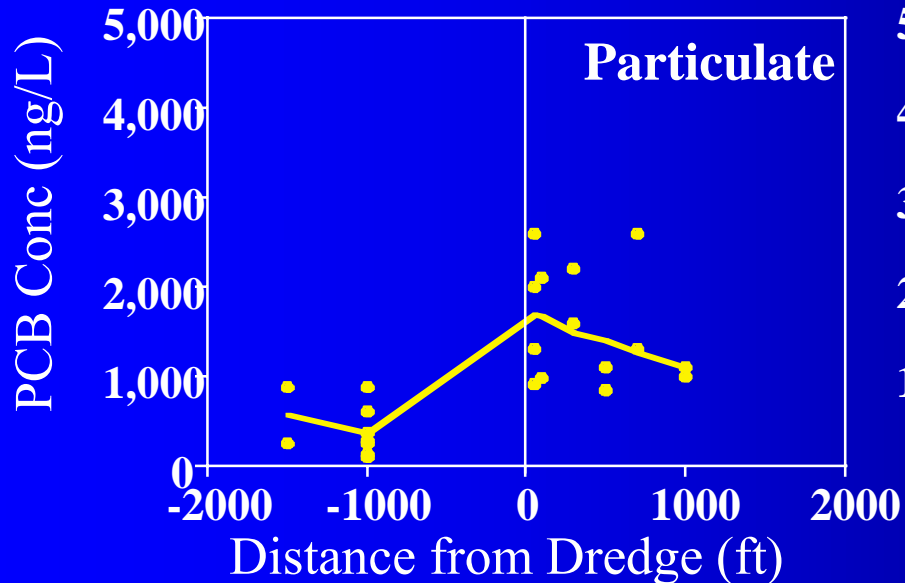
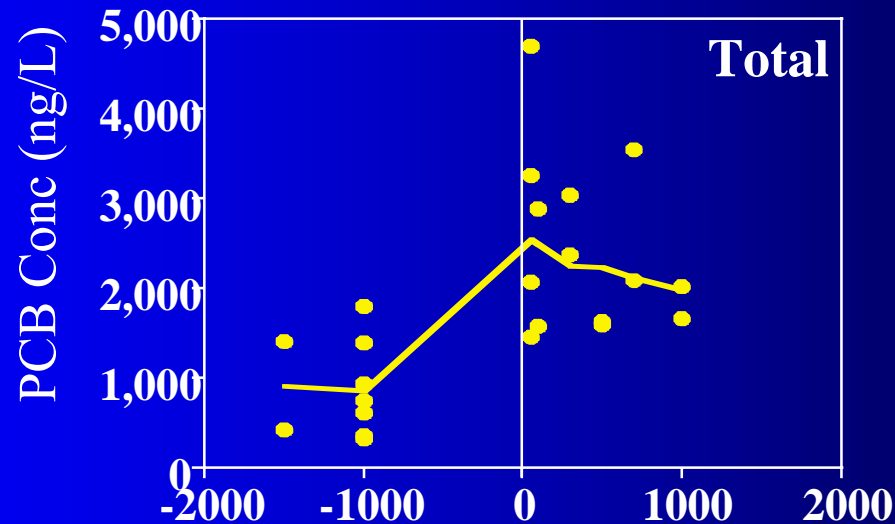
New Bedford Harbor PCB Export at 0.36 Percent of Mass Removed

Figure 2-3.

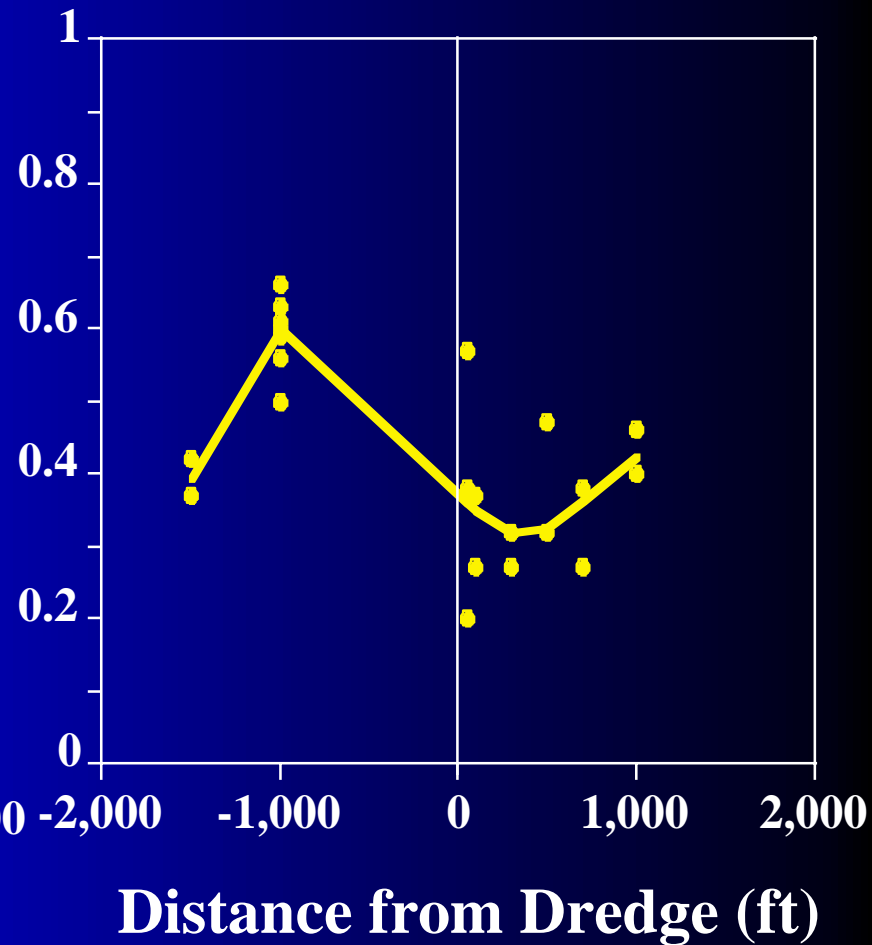
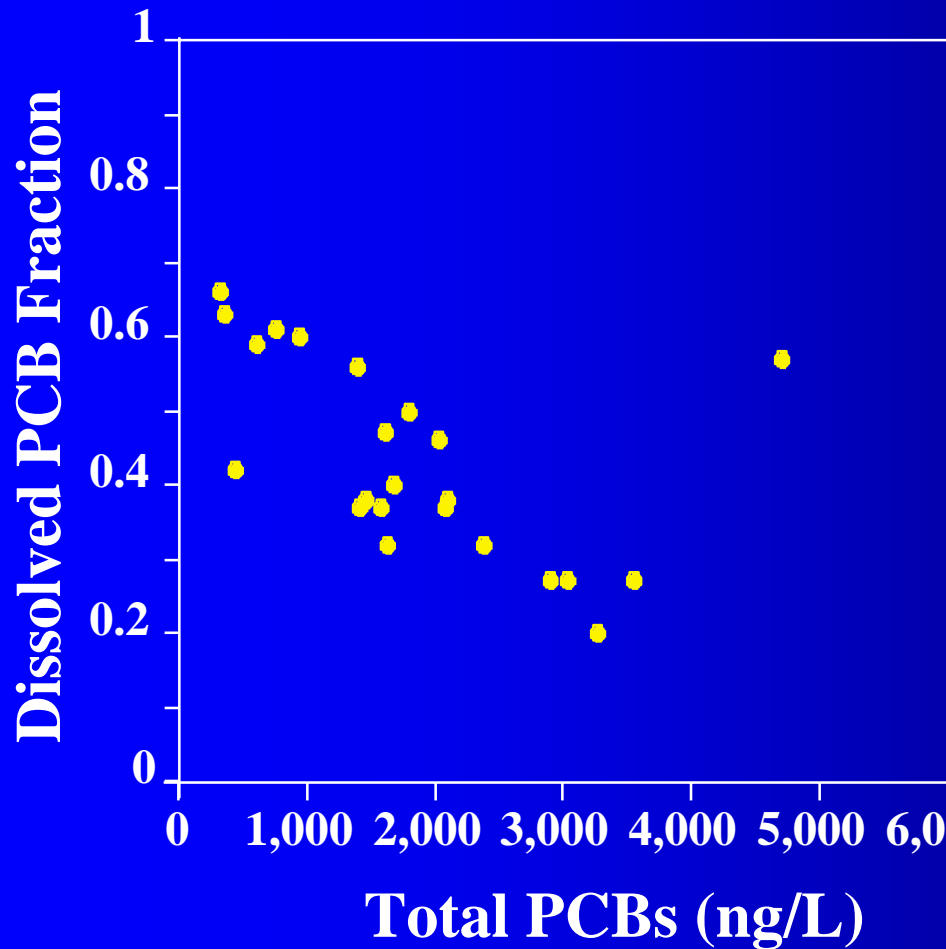
Net Transport of PCBs under the Coggeshall St. Bridge.
Values represent kg per tidal cycle on dredging days.



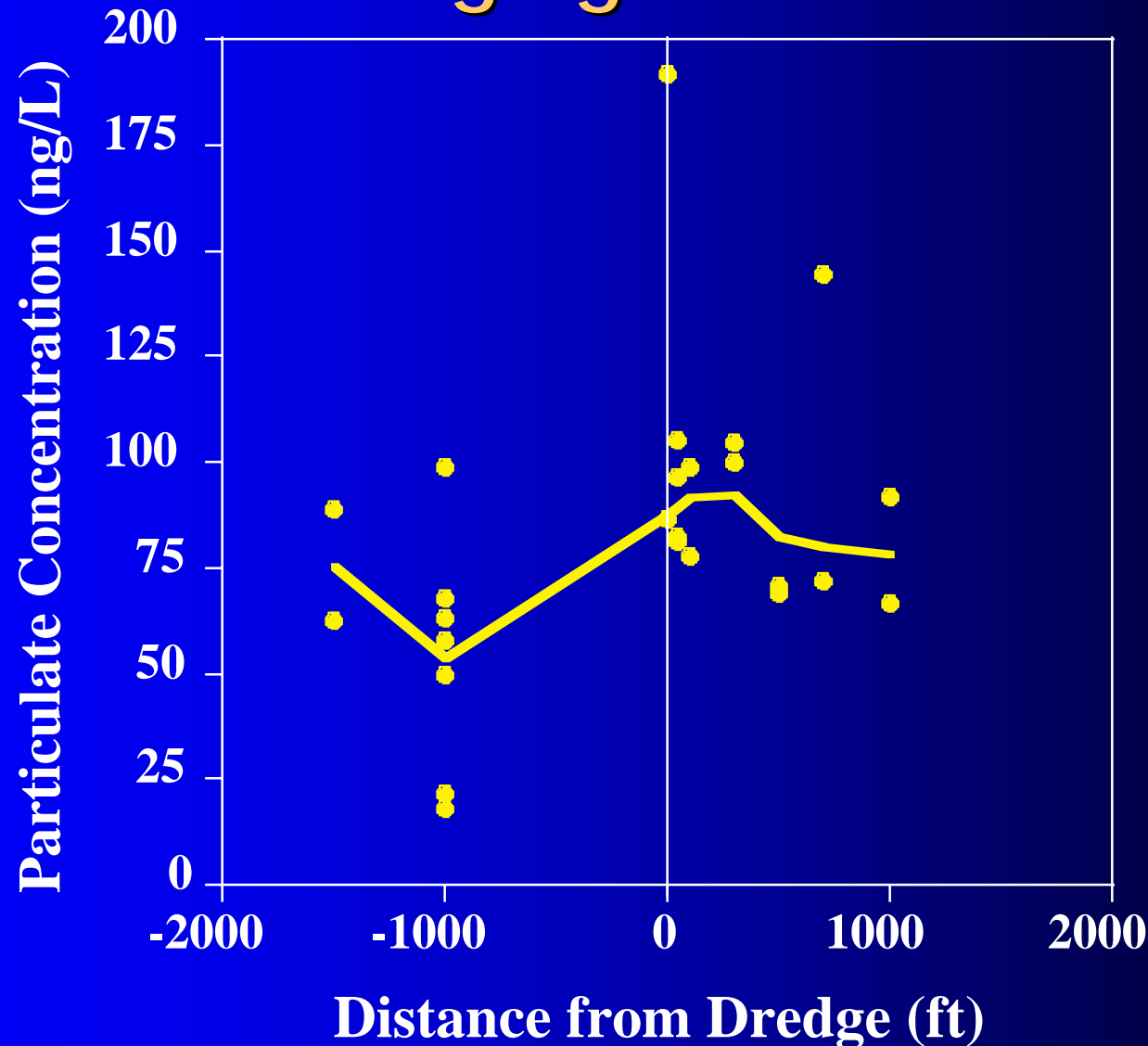
Primary Dredging Release as Particulate Matter at NBH Demonstration Project



Dissolved PCB Fraction Varies Inversely Total PCB and Distance

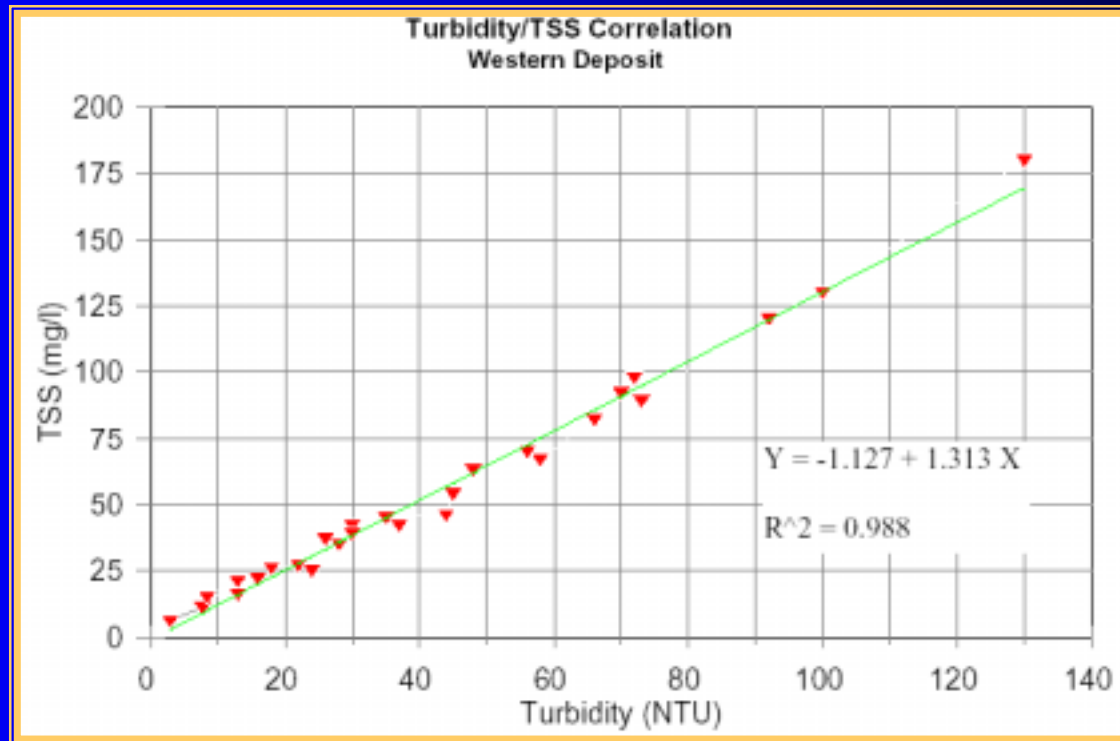


Downstream TSS Signal Due to Dredging at NBH



Bench Test Correlations between Suspended Solids and Turbidity

Fox River Deposit N



$$SS = -1.27 + 1.313 \times \text{Turbidity}; r^2 = 0.98$$

Where: SS = suspended solids in mg/L, and
Turbidity = turbidity in NTU.

Anticipated Refinements

- **Pre-Phase 1 Refinements**
- **Possible Phase 2 Revisions**

Pre-Phase 1 Anticipated Refinements

- Far-Field Monitoring
 - PCB Load-Based Action Levels - limits may be adjusted if
 - PCB removal mass \gg original estimate
 - Remediation schedule \neq assumed schedule
- Engineering Contingencies
 - Contingencies determined as part of the remedial design

Phase 2 Anticipated Refinements

- Far-Field Monitoring
 - Sampling Frequency
 - May be reduced if little impact at the far-field stations and the SS measurements serve as a real-time indicator
 - PCB Load-Based Action Levels
 - May be adjusted if the remediation schedule differs from the assumed schedule

Phase 2 Anticipated Refinements

- Far-Field Monitoring (cont.)
 - PCB Concentration-Based Action Levels
 - The 350 ng/L Total PCB action level may be adjusted downward if a lower concentration is needed to provide a larger margin of safety for the public water supply
 - SS-Based Action Levels
 - May be adjusted using the Phase 1 paired SS and PCB results

Phase 2 Anticipated Refinements

- Turnaround Times
 - May be relaxed if:
 - few occurrences and
 - SS/turbidity measurements = real-time indicator

Phase 2 Anticipated Refinements

- Near-Field Monitoring
 - Stations
 - Location and number based on Phase 1 results
 - SS-Based Action Levels
 - Based on Phase 1 near-field SS concentrations and far-field SS and PCB concentrations
- Engineering Contingencies
 - As needed

Resuspension Performance Standard Summary

Protection and Flexibility

- Pro-Active Structure:
 - Avoids shutdowns
 - Ensures compliance
- Criteria derived from “Real” limits
 - Best engineering estimates
 - Federal MCL
 - Measurement Sensitivity
 - Near-field and Far-field
- Monitoring serves 2 goals
 - Improved understanding
 - Compliance

Resuspension Performance Standard Summary

Protection and Flexibility (cont.)

- Two Measures: TSS/Turbidity and PCBs
 - Real time
 - Affirmation
- Engineering Contingencies
 - Required but not specified
 - Occur before primary standard is exceeded
- Flexible Framework
 - Phase 2 adjustments

Public Comments

Public Comment Concerns

- Protection of ecology and human health
- Monitoring scope

Protection of Ecology and Human Health Comments

Comment: Performance standard and action levels are not adequately protective and will not protect aquatic resources.

Response

- Compliance with the resuspension performance standard criteria will ensure that the Total PCB water column concentrations meet the requirements of the Safe Drinking Water Act.
- Fish body burdens may rise during the remediation itself, they will rapidly decline upon completion of the remediation according to model projections.

Monitoring Scope Comments

Comments

- EPA's proposed monitoring requirements are too extensive; hard to implement and expensive.

Monitoring Scope Comments

Response

- The cost of the monitoring is highly dependent on the quality of the design and operations.
- DQOs are provided for each aspect of the standard. The number of samples is justified by statistical analysis.
- Similar sampling events have been conducted on the Hudson (PCBs) or are standard practice for dredging (solids and turbidity).

Action Level Comments

Comment

- Dredging will contaminate downstream areas, especially if barriers are not used.

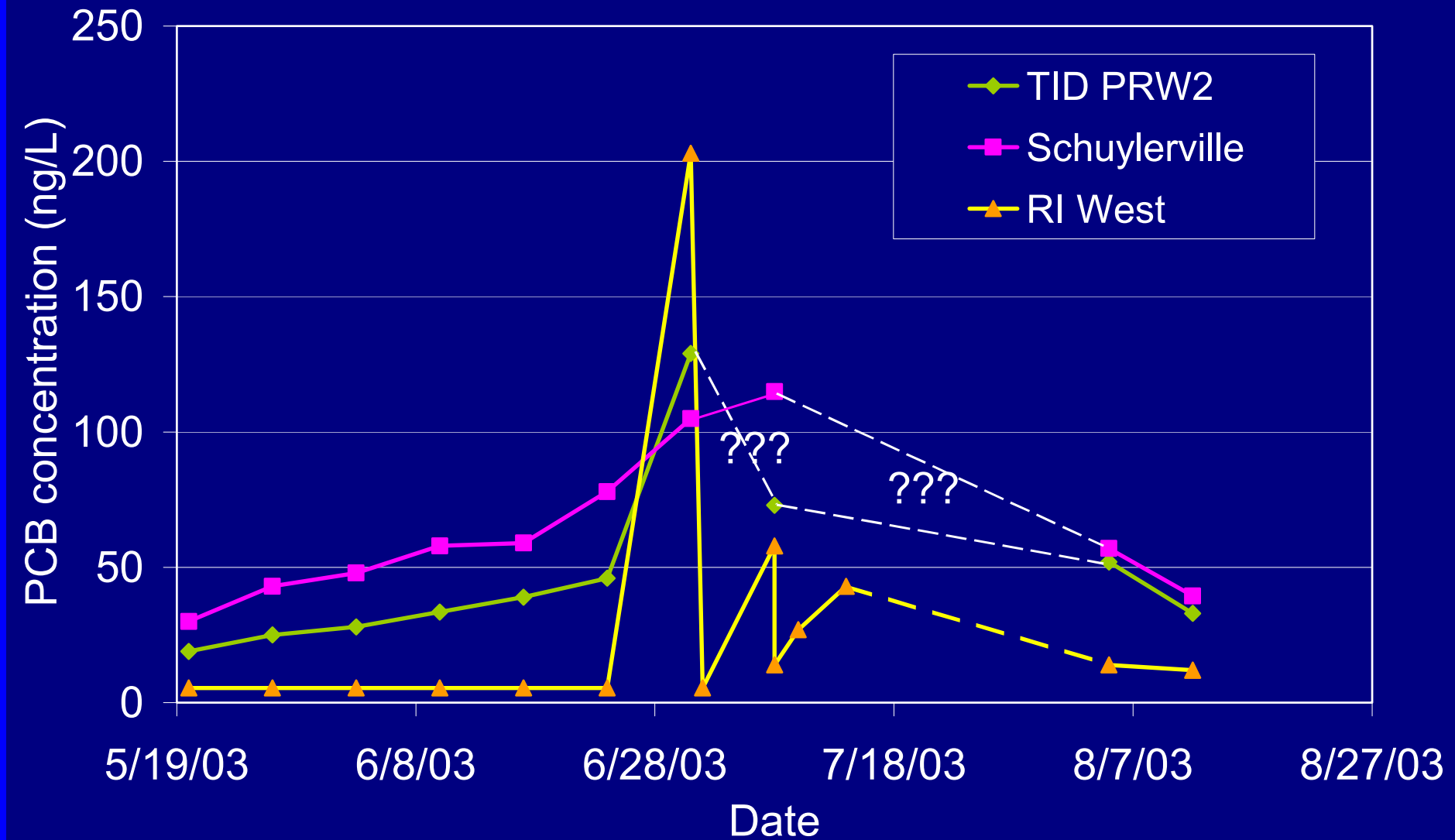
Action Level Comments

Response

- Dredging from upstream to downstream is recommended.
- The extent to which non-target areas downstream from the dredge areas are contaminated will be addressed in the remedial design.

END

OU4



OU4

